

May 5, 1958

# Aviation Week

*Including Space Technology*

75 cents

A McGraw-Hill Publication

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Missions Reveal  
Crew Problems

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第15章 亂世：魏晉南北朝時期

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 Austin Hydrology Division • Austin Office: 1000 Congress Avenue  
 Austin, Texas, P.O. Box 1140 • George E. Woodcock, Director  
 Additional Service Facilities: 100 West Street • Washington, D. C. 20585 • Western Wing,  
 404½ North Dearborn Street, Chicago, Illinois 60610

TELEGRAMS: Taken R.E.S. Dated THURSDAY 26th NOV. 1919. 10.00  
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detunaging turbines, massive work, enhanced research and production, instrument overhauls, design and manufacture of remote channel indicators, technical publication writing, design and production of electrical, electronic, hydraulic, and mechanical components and power plant systems, helicopter maintenance, fabrication of refueling wing-pods, research in aerodynamics. From writing circuit designs and algorithms to complete modification of multi-engine aircraft. Hayes has the facility and the skilled staff necessary for engineering, manufacturing, quality control and cost control in widely diversified work assignments.

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• 第二十二章



## AVIATION CALENDAR

- Mar 12-14-National Conference on Acoustical Electronics, sponsored by Institute of Radio Engineers, Institute Hotel, Dayton, Ohio.  
May 12-14-Annual Convention General HRC, Hotel Statler, 120 W. 42nd Street, New York, N.Y., and Hotel San Jose Plaza, San Jose, Calif.-on plane and antenna methods for aerial and ground targets. Binghamton Hotel, Administration Bldg., Binghamton, N.Y., and Cornell Cooking Club, Worcester, Conn., May 13-14.  
May 14-16-Highfidelity Marketing Meeting, Hotel Mississippi, St. Louis, Mo., presented by American Society of Appraisers, Hotel Mississippi, Cleveland, Ohio.  
May 18-22-15th Annual National Conference, Society of Acoustical Engineers, Hotel Roosevelt, Newark, N.J., and Hotel Penn, Newark, N.J., and Hotel New Yorker, New York City.  
May 21-23-Flight Safety Foundation Int'l., Regional Branches Aircraft Sales Section, Palms Hotel, Chicago, Ill.  
May 28-June 1-Acoustic Warfare Seminar, sponsored by the Shreveport Defense Institute, Texarkana, Tex.  
June 24-26-National Telecommunications Conference, Hotel Johnson, Hotel Jefferson, Md.  
July 15-18-Congr. Vibration, Seismology, and Non-destructive testing for the Service of Aircraft Materials and Process Engineers and the Vibrationists, Von Institute of Acoustical Sciences, Bldg. 100, Los Angeles, Calif.  
Aug 1-5-International Conference on Production Techniques, sponsored by the Institute of Radio Engineers Professional Group on Production Techniques, Hotel New Yorker, New York, N.Y.  
Aug 14-16-15th Annual National Meeting, Society of Acoustical Engineers, Hotel New Yorker, New York, N.Y.  
Sept 9-12-American Society of Appraisers, Hotel Pennsylvania, New York City.

Oxford University Press

ANIMATION 2018 Industry Award Recipients



Chesapeake Energy Corp., which has been involved in several disputes with the state over its drilling activities, has agreed to pay \$1.2 million to settle a civil enforcement action brought by the state's attorney general.

*Journal of Clinical Endocrinology and Metabolism*, Vol. 103, No. 1, January 1994, pp. 103-107.

2014年1月期 第1号



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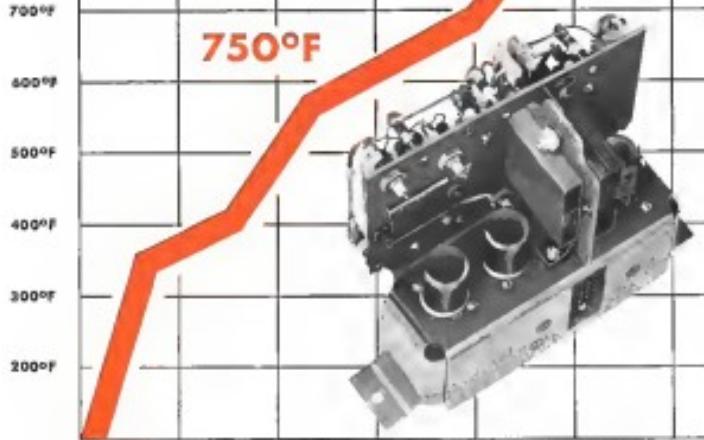
## AVIATION CALENDAR

(Continued from page 5)

June 15-16—Meeting of American Electronics Association, Hotel Statler, Los Angeles, Calif.  
June 15-17—French International Aeronautical Congress and Congress Collective, New York, N.Y.  
June 16-18—Second National Convention on Military Electronics, Sheraton Park Hotel, Washington, D.C.  
June 22-24—Annual Meeting, Flying American Society, Flying Museum, Hotel Statler, Boston, Mass.  
June 24-26—1st Meeting, Systems Distributors and Manufacturers Assn., Mount Washington Hotel, Bretton Woods, N.H.  
June 25-27—1st International Conference American Institute of Mechanical Engineers, Hotel Statler, Buffalo, N.Y.  
June 27—71st Annual Wards' Hospital Equipment Show sponsored by the Bureau of Army Medicine, Army Medical Institute of Technology, Holabird, N.Y.  
July 4-6—5th Annual Aviation Logistics Course, Airport, Pittsburgh, Pa.  
July 8-14—The Institute of the Aerospace Sciences Annual Summer Meeting, Wilshire Hotel, Los Angeles, Calif.  
July 14-15—Technical Inspection, National Motion Picture Committee, Los Angeles, Calif.  
July 15-16—15th Annual Symposium on Computer and Data Processing, Mayflower Hotel, Dallas, Tex.  
Aug. 4-5—Second Technical Conference on Non-linear Vibrations and Vibration Analysis sponsored by the Institute of Thermal Engineers, Hotel Statler, New York, N.Y.  
Aug. 18-23—Conference on Electronic Standards and Measurements, National Bureau of Standards, Boulder, Colo., jointly sponsored by NBS, American Institute of Electrical Engineers and Institute of Radio Engineers.

Sept. 19-23—Western Electronic Show & Convention, Statler Hotel, Los Angeles, Calif.  
Sept. 21-30—North American Congress, LeTourneau, International Federation, Atlanta, Ga.  
Sept. 27-29—1956 International Hydraulics and Lubrication Society of British Columbia Convention, Vancouver, B.C., Canada.  
Sept. 3-5—1956 Cognac Engineering Conference, Hotel de la Cognac, Cognac, France.

Sept. 5-10—International Aviation Show, Gobanai, New York, N.Y.  
Sept. 8-13—International Congress of the Astronautical Sciences, Palace Hotel, Valencia, Spain.  
Sept. 8-13—Dynamics of Flight, University of Michigan, Ypsilanti, Mich., for participating countries. For details, R.M. Hous, Dept. of Aeronautical Engineering, 1421 East Engineering Blvd., University of Michigan, Ann Arbor, Mich.  
Sept. 12-14—1956 Meeting, International Council on Tribology, Royal Holloway College, Egham, Surrey, England.



This General Electric designed and developed amplifier operates without the use of refrigerants at ambient temperatures from -47°F to 750°F.

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1645...LVT (A) 7  
Amphibious Personnel Cargo Carrier



1648...LVT (A) 8  
Amphibious Armored Assault Vehicle



1651...M-102  
Armored Personnel Carrier



1654...LVT (P) 6  
Amphibious Armored Personnel Cargo Carrier



1658...LVTR-1  
Armored Vehicle for recovery duty



1657...M-104  
Motor Gunner Vehicle

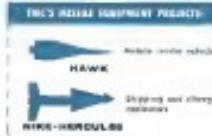
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1657...HAWK  
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1659...THOR  
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CORPORATION

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The Waldorf Instrument Company's Fluid Systems Division recently undertook research and development activity in unique control problems for aircraft gas turbine engines. It was required that a hydraulics unit be supplied which would provide the specified in-pulse load position actuators and emergency fuel interlock and override mechanisms.

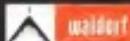
A compact package was designed which housed the following elements:

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- FREQUENCY LIMITING MECHANISM

The control meets all requirements of military specification MIL-E-4000A.

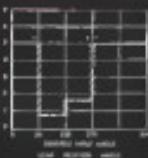
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For further information, contact —



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Dr. W. H. Koenig, past president of the Society who is now Associate Director for Administration at NOL, speaks to guests during a recent visit to the Naval Ordnance Laboratory.

May 5, 1968

# Aviation Week Including Space Technology

Vol. 88, No. 18  
Member ACP and ABC

EDITOR-IN-CHIEF: New York: 200 Park Ave., 10th Fl., New York, NY 10022. Telephone: 2-4200. Washington: 411 F Street, N.W., Suite 1000. Telephone: 555-1240. Boston: 100 Summer St., Suite 1000. Telephone: 3-2111. Memphis: 100 South Main St., Suite 1000. Telephone: 2-2111. Dallas: 1000 Ross Ave., Suite 1000. Telephone: 2-2111. Atlanta: 100 Peachtree St., Suite 1000. Telephone: 5-2111. Seattle: 1000 Second Ave., Suite 1000. Telephone: 6-2111. San Francisco: 1000 Market St., Suite 1000. Telephone: 3-2111. Chicago: 100 N. Dearborn St., Suite 1000. Telephone: 4-2111. Los Angeles: 1000 Wilshire Blvd., Suite 1000. Telephone: 2-2111. Honolulu: 1000 Ala Moana Blvd., Suite 1000. Telephone: 5-2111. Denver: 1000 17th St., Suite 1000. Telephone: 3-2111. Portland: 1000 S.W. Yamhill St., Suite 1000. Telephone: 2-2111. Miami: 1000 Brickell Ave., Suite 1000. Telephone: 5-2111. St. Louis: 1000 Locust St., Suite 1000. Telephone: 3-2111. Philadelphia: 1000 Market St., Suite 1000. Telephone: 5-2111. Houston: 1000 Main St., Suite 1000. Telephone: 2-2111. Pittsburgh: 1000 Penn Ave., Suite 1000. Telephone: 2-2111. Anchorage: 1000 Fourth Ave., Suite 1000. Telephone: 2-2111. Anchorage: 1000 Fourth Ave., Suite 1000. Telephone: 2-2111.

## FROM UNDERSEAS TO OUTER SPACE—WEAPONS OF THE NAVAL ORDNANCE LABORATORY GUARD OUR FREEDOM

Basic and applied research—and the development of advanced weapons for underwater, surface and air warheads—are the vital missions of the U.S. Naval Ordnance Laboratory near Silver Spring, Md.

Established in 1918 as a small experimental group to design sea mines and torpedoes, NOL has become one of the nation's most respected institutions for military research and development. These thousand persons, including 1,000 engineers and technicians, work at its modern \$50 million facility.

In its forty years, the Laboratory has made many notable contributions in science and technology, and to our national defense. In World War II, well-developed sea mines helped to strangle Japan's supply lines. More recently, work on sonars, missiles and other subsystems greatly speeded the development of these needed missiles. The sonar depth charge was never invented and perfected by NOL in less than five years; now provides the U.S. Fleet a massive defense against hidden sea submarines.

Today, NOL's work embraces virtually the entire field of advanced weapons design. One highlight is the

Laboratory's present key role in the development of missiles, the nuclear-capable missile that our allies know will soon be able to launch while in range of off enemy shores. This is one of many new weapons that NOL is developing or working with at present—weapons that can defend the free world as it生存。

But in the long run, some of NOL's other work is equally as important. Research in basic science can influence war in unexpected ways. For example, the advanced mathematics studies carried on at NOL, which already has solved some of the more difficult problems, may help unlock the remaining doors to interplanetary space travel. Or, say, a work on advanced elasticity may produce entirely new and better types of metals, plastics and other substances. Or, NOL's basic research in physics and math may even form a key to the internal structure of subatomic particles, and open up whole new worlds for science and mankind.

Thus the Naval Ordnance Laboratory aids our nation in two ways: by developing weapons that will ensure the survival of freedom, and by finding new scientific knowledge that will catch us free.

WT



Region of Ford Instrument Co. should cut four-year design cycle and look to the U.S. Navy's influence of Defense



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TELETYPE ROOM Robert D. Shantz, Harry Brown  
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### Man's Scientific Space Role Debated

26

► Panel at AFOSR Aerospace Symposium questions whether man will be useful or merely "old meat."

### Airlines May Face Military Traffic Loss

40

► Defense officials foresee division of traffic if lawmaker's proposal to drag aircraft is approved.

### JetStar Appears to Meet USAF Needs

78

► Performance and characteristics indicate that Lockheed CL-329 fulfills USAF utility aircraft requirements.

### SPACE TECHNOLOGY

81

► Man's Journey Beyond Earth  
#147 Moonbase Green Conditions  
NASA Proposes Recovery Satellite  
Oscillating Debris Space Control Plan  
Perseus Adds NASA Authority  
to Develop Space Shuttle  
Cerny: Radiation Space Problem  
Carter: Weightless Space Power

82

► Air Force Misses Multiple Launch Loss  
Air Force Launch Test  
Mitsubishi Starts Space Program  
Vanguard Second Stage  
Optical Telemetry Checks Satellites

83

► AIR TRAFFIC CONTROL  
Air Force Puts People Inside Simek Work  
Hawks Fly Pacific Test  
Hawks Fly Pacific Test  
New Model Starts Aircraft Testing  
Private Eyes

84

► MANAGEMENT  
Executive Pay  
Pentagon's Management  
West Coast Strike Threat  
White House  
Industry Observers  
Killer Center  
Exxon Corp., Getty  
Radio Help Spectrum Control

85

► AERONAUTICAL ENGINEERING  
Airline Pilot Report  
78

► AVIONICS  
Tire Tests and Reliability  
Shoeless Test S-38 Rapid Control  
Killer Center  
Exxon Corp., Getty  
Radio Help Spectrum Control

86

► EDITORIAL  
Toward a National Space Policy  
31

Cover: Second prototype Lockheed CL-329 JetStar is about to begin a series of instrument flight tests, carrying a select crew including headquarters. JetStar was designed to fulfill USAF requirements for a fast, all-weather cold-weather aircraft. Additional photos of the JetStar are included in an Aviation Week pilot report on the second prototype beginning on page 78.

### PACIFIC CRISIS

87

► China: 20-24 April  
Philippines: 26-28 April  
Indonesia: 27-28 April  
Thailand: 28-29 April  
Japan: 29-30 April  
Korea: 30 April-1 May  
Russia: 1-2 May  
India: 2-3 May  
Sri Lanka: 3-4 May  
Malaysia: 4-5 May  
Singapore: 5-6 May  
Australia: 6-7 May  
New Zealand: 7-8 May  
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Mexico: 18-19 May  
Central America: 19-20 May  
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Bolivia: 25-26 May  
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Mexico: 30-31 May  
Central America: 31 May-1 June  
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Mexico: 35-36 June  
Central America: 36-37 June  
Argentina: 37-38 June  
Brazil: 38-39 June  
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Uruguay: 40-41 June  
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Bolivia: 42-43 June  
Peru: 43-44 June  
Ecuador: 44-45 June  
Colombia: 45-46 June  
Venezuela: 46-47 June  
Mexico: 47-48 June  
Central America: 48-49 June  
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Central America: 84-85 June  
Argentina: 85-86 June  
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Venezuela: 94-95 June  
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Central America: 156-157 June  
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Central America: 384-385 June  
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Colombia: 417-418 June  
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Central America: 420-421 June  
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Central America: 432-433 June  
Argentina: 433-434 June  
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Central America: 468-469 June  
Argentina: 469-470 June  
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Chile: 471-472 June  
Uruguay: 472-473 June  
Paraguay: 473-474 June  
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Ecuador: 476-477 June  
Colombia: 477-478 June  
Venezuela: 478-479 June  
Mexico: 479-480 June  
Central America: 480-481 June  
Argentina: 481-482 June  
Brazil: 482-483 June  
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Paraguay: 485-486 June  
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Ecuador: 488-489 June  
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Venezuela: 490-491 June  
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Central America: 492-493 June  
Argentina: 493-494 June  
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Chile: 495-496 June  
Uruguay: 496-497 June  
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Peru: 499-500 June  
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Colombia: 501-502 June  
Venezuela: 502-503 June  
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Central America: 504-505 June  
Argentina: 505-506 June  
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Paraguay: 509-510 June  
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# EDITORIAL

## Toward a National Space Policy

Last week in Denver we indulged in two days of useful formulation on technical problems of space exploration along with about 1,100 representatives of the military services, aviation industry, and research organizations. October was the second Aerospace Symposium sponsored by the Air Force Office of Scientific Research, the technical details of which are reported on page 26. This exercise was an extremely valuable step along the road toward eventual formulation of a national space policy. It was interesting to note that the first such AFOSR conference held in the pre-Sputnik era last year at San Diego with joint sponsoring of Convair's Aerospace Division attracted 100 participants and severe depletion from the top military and civilian leaders of our government.

This year in the post-Sputnik era, attendance more than doubled, and the only argument was over how soon and how much space exploration could be accomplished. Last year Brig. Gen. H. F. Gregory, who commanded AFOSR and was a pioneer in US aerospace development more than a decade ago, took a beating from his superiors and the dole press for his statement in the San Diego symposium that "right outside the atmosphere is a reality." Although it may be somewhat early to be building space ships, it is not too early to start thinking about it.

This year, Gen. Gregory was invited to some unusual note thumping at his office, for events have proved his allegedly wild prophecy was really a most conservative estimate of the situation, and today the Air Force is scrambling into space with a wide variety of manned and unmanned vehicles.

### Future Knowledge

In his keynote speech to the Denver assembly, Gen. Gregory also had some other thoughts that are worth exploring. "Future knowledge will stem from certain principles that have guided the human race past and will still continue to guide us in the future." He told the symposium that "the first of all these is that there is a single continuum which surrounds the earth. Air and space are convenient ways of describing several parts of what really is a unified phenomenon. An effort to define a dividing line between these two is so artificial that it should be apparent that we are talking of a single medium. Similarly, a distinction between meteorites and astronauts is a convenient way of describing specific segments of one applied science which deals with the infinite realm of the atom."

Gen. Gregory also argued that we Americans can no longer enjoy an exclusive hunting license in the area of scientific exploration. He said, "It is open territory for any nation desiring to effect a scientific probe into the secrets of the universe. Such activity, however, is not of the kind we normally associate with a military operation. They are available to all men irrespective of the motivation that impels their discovery. They cannot be held as a private domain by arbitrary security classifications nor

can a scientific breakthrough by a would-be aggressor be rationaled as a security violation, a component of the taking of something that is rightfully ours.... One of the most important jobs to be done in research and development today is that of ensuring the adequate flow of research information."

Dr. Clifford G. Ferris, chancellor of the University of Buffalo and former Assistant Secretary of Defense for Research and Development, also emphasized the need for an honest and adequate flow of public information on national space policy and its scientific problems. "If the public is largely honest and fully informed of the military, political, scientific and technological aspects, I believe it will continue to support the exploration of space and many other important matters. If the information is spotty, misleading and less than straightforward, then confidence as well as motivation will wane and can only be gained by another major crisis. Then it may be too late."

### Solid Foundation

We heartily agree with Dr. Ferris on this vital point. We cannot afford the traditional start and stop, frame and fenced programs in a national space program that have so visited our defense effort in the past and wasted billions of dollars without achieving the required results. A sound and effective national space policy, like any other national program, must be firmly based on a solid foundation of public understanding and support.

Everybody concerned with developing a sound national space policy must continuously contribute to the effort required to achieve a higher degree of technical literacy and general understanding of space problems with the public and the Congress that represents it. One distinguishes for itself the difference between citizen studies in space and mixed scientific programs and can spot the difference between the space race idea and the scientists generally interested only in adding to the sum total of man's knowledge of himself and his universe. At this late date, the need for a prominent effective national space policy based on civil bonds as well as possible military requirements should be evident to every citizen.

Unfortunately, this is not the case and a great deal more convincing is required before even the top leadership of our government fully understands the problem and the absolute necessity for solving it on a long term basis. We hope the last beginning of a sound national space policy.

However, events such as the AFOSR symposium which must certainly should be continued on an annual basis, and the public hearings now enabling before the House Select Committee on Astronautics and Space Exploration are extremely necessary and vital contributions to the eventual formulation of a scientifically solid space program tailored to meet our national needs and genuinely enhance our international prestige.

—Robert H. Stine

## New B.F. Goodrich Fabric Tread Tire outlasts other jet tires 5 to 1

This new combat training tire survives up to five times as many high-speed flights and landings as tires previously used on the CH-46. Lockheed is making a study of the new tire, developed by B.F. Goodrich, for the *YU-955* (left). In addition to the fabric-treaded Tires, the company has won an F-101 for the major Cessna aircraft of the Republic P-47 Thunderbolt. This plane is the first to fly 500 hours in continuous combat without a single tire blowout. The new tire has made its mark in 25 million miles of flight time on B.F. Goodrich's Fabric Tread *YU-955* and no sign of age. Other tire performance is as good.

**B.F.Goodrich** aviation products



# Look to the leader for the latest in air safety!



In an emergency, amphibious in an instant! In this helicopter installation, cage-mounted floats are inflated in seconds by Kidde's INFLATAIR units. They employ bottled 3000 psi air to aspirate fine air into the floats at a rate as high as 20 to 1.

Product of Kidde's years of experience with inflation systems for life rafts, this fast-acting INFLATAIR has proved its usefulness in ground inflation uses such as lifting bags, emergency escape chutes, drogue and main recovery cushions. Its further applications are practically unlimited.

**Walter Kidde & Company, Inc., Aviation Division**  
518 Main Street, Belleville 9, N.J.



Airbus Helicopters Office  
Route 100, Dept. A-100, Box 84  
Bordentown, New Jersey 08505  
Phone: (609) 722-1000

"Kidde" Kilders Ranch #15, A&S Expedition, June 9-10, Hotel Hotel, Los Angeles"



**Fire and Overheat Detector**  
Kidde's combined Fire and Overheat Detector, part of an integrated system, has been proven successful by more than seven years of continuous flight experience on 15 kinds of aircraft!



**Aircraft Crash Fire Protection**  
Designed and perfected for engines with more than 20 years in aircraft use, Kidde's Crash Fire Protection System has long been instantaneous and dependable fire protection. They are available with a wide variety of extinguishing agents.



**Aircraft Crash Fire Protection**  
An example of the ultra-rapid response system, Kidde's Crash Fire Protection device uses a fast-acting pressure device used in full-scale Aircraft Crash Fire Protection tests.



**Portable Fire Extinguishers**  
Fast and Portable Aircraft Fire Extinguishers, Kidde offers you a complete line, bringing you a standard of quality and dependability that has been second to none for more than 30 years!

## WHO'S WHERE

### In the Front Office

**Paul L. Roberts**, a director, Aeromac Manufacturing Corp., Middlebury, Ohio, has been appointed Vice Pres., Sales Div. (USA), mfg. & Service, Aeromac Co., Corp., Middlebury.

**J. E. Flatt**, president and general manager, Aero Arrest Ltd., Melton Mowbray, Leicestershire, England.

**Ron R. Eppert** succeeds John S. Colvin as president, Through Corp., Dept. C, New York City.

**Art Verner**, president, Philips Electronics Inc., New York, N.Y., succeeded Peter van den Berg, who has joined chairman.

**William Kneller, Jr.**, vice president and general manager, Rockwell Corp., Pasadena, Calif.

**Space Technology Laboratories**, division of Rockwell Corp., Los Angeles, Calif., has renamed the following executives: Dr. Milton U. Chotzin, vice president and director, Physical Research Laboratory; Dr. Donald L. Johnson, director, Aerodynamics Laboratory; William F. Dako, vice president and associate director, Systems Engineering Division.

**Robert J. Eberle**, former director of Washington National Airport, has joined Howard, Needles, Tammen and Bergendoff Consulting Engineers, New York, N.Y.

### Honors and Elections

**E. Claude Krue**, president of Ryan Aeronautical Co., has been named by the American Schools and Colleges Assn. as a recipient of the 1961 annual Honors Award.

**Franz B. Widle**, assistant executive and a panel member of the Rockwell Foundation Fund, has been elected to the Board of Governors of the Anti-Missile War Fund Foundation Inc., New York, N.Y.

**C. F. Zimmerman**, head of Governmental Affairs Committee, Department, has been appointed to the Board of Directors of The National Business Aviation Assn. - Washington D.C. Chapter.

**Lester L. Lasker**, professor of aeronautics at the California Institute of Technology, has been appointed to the Working Group on Recovery of the National Military Commission for Aeronautics, Washington, D.C.

**Dr. John R. Dawson** has been named Dean of New York University's College of Engineering, New York, N.Y.

### Changes

**Allen J. Brooks**, manager-aerospace applications, Computer Department, General Electric Co., Phoenix, Ariz.

**W. A. (Dale) Pabes**, chief engineer, Georgia Division, Lockheed Aircraft Corp., Marietta, Ga. His father succeeds K. W. Middleford who has been named director of the newly formed Georgia Nuclear Laboratory.

**Clarence H. Smith**, who has been appointed to Aeromac Division, Manzano Air Force Base, Roswell, New Mexico, has been promoted to Manager, Kirtland Air Force Base, New Mexico.

(Continued on p. 129)

## INDUSTRY OBSERVER

**New Boeing** supersonic delta wing bomber with an turbofan engine is now undergoing flight test. Early reports indicate the results indicate that it may have performance capabilities similar to those of USAF's B-70 developed before the new aircraft stage at North American Aviation.

**Major improvement** in effectiveness of airborne electronic countermeasures is expected through use of fundamentally new kinds of specialized disadvantaged antennas whose inherent portability and portability can be quickly changed by ECM operators to counter many anti-ECM threats. Theory has not yet been developed which fully explains how new antenna functions, but this will be done later application. New antenna design was developed by Wright Air Development Center engineers and university of Illinois scientists.

**Flight control system** which automatically adjust their performance to give optimum stabilization on new aircraft models without extensive flight testing, without prior knowledge of vehicle characteristics or use of an data storage and change now required, have been successfully flight tested by Wright Air Development Center. New adaptive techniques, studied for use on several new flight control systems now under development, should quickly speed up flight tests of new aircraft models.

**Wright Air Development Center** is negotiating a \$2.5 million contract with Coming Glass Works for development of windshields to operate above Mach 5. Our configuration will be flat, which will include single and complex curved surfaces. Windshield will consist of a sandwich of two panels of glass with an electrically conductive coating on the outside for deicing.

**At** **Air Force** aircraft aided both Lockheed and Convair to submit designs for a low-level, nuclear-powered bomber.

**Army's Redstone** anti-satellite system scheduled as part of Operation Hardwick in the Pacific (AW Jan 26, p. 26) probably will be canceled. Air Force says that seeking data needed to the design of anti-satellite weapon systems will be carried out, however.

**Russian** have used metal shoring projectiles in recent tests in which men have been shot to more than 600,000 ft and successfully returned to earth. Russians apparently are proceeding in the same steps they number in the U.S. toward putting man into space rather than trying a one-shot attempt on a rock basis and risk losing the subject in a burning rocket.

**New air defense system** designated Project Sekhmet is being developed for Air Defense Command by Fairchild Engine and Airplane Co. and Hughes Tool Co.

**Kaman Aircraft Corp.** is mapping a sales campaign for its K-600 component helicopter, a version of the company's HK model. Major changes in the tail configuration. Two-seat version will have been added for soldiers instead of three. The K-600 is equipped with Kaman's new night-fighting training device which permits the pilot to adjust the rotor blade track angle off flight. The K-600 will be built in the United States, Kaman will proceed with FAA certification. Pre-piloted by a Prost & Whiteman R-1150 engine developing 500 hp, Prototyp will be used as a demonstrator to potential commercial and foreign military customers.

**Japanese-built Sikorsky S-55** helicopters will cost \$166,666 each. Mitsubishi is expected to build a total of 25 S-55s in fiscal 1958 and 1959, from 15 to 15 in fiscal 1960, for the Japanese Self Defense Agency. Japanese power engineers, private citizens, airlines and other businesses firms are believed to have placed additional orders for approximately 50 of the helicopters.

**Prominent** nations indicate that excess floor space in assault and assault aircraft now total 57 million sq ft in 1961. Apparently one year ago, the figure stood at 22 million sq ft.

## CREATIVITY and PRODUCIBILITY

Basic research has been described as "a search for knowledge, untroubled by production demands." At Avco, we realize that fundamental new ideas cannot be programmed in advance to fit the needs of even the highest priority schedule. There will always be room here for this kind of basic creative work.

Yet, as an industrial research operation, we want to realize the material benefits that have historically resulted from scientific breakthroughs. Economic concern seems and rationality require an industrial research structure that can transform the idea in a scientist's brain into valuable, useful hardware.

We see nothing inconsistent in the pursuit of new products simultaneously with the pursuit of new ideas—and doing both under the same roof. Rather, we feel that the continuous feedback resulting from close association of basic research people, applied scientists and engineers, test engineers and product engineers does as much for creativity as for producibility. And America's future depends upon a good supply of both.

*Robert D. George*

Robert D. George,  
Manager, Prototype Development Department



Robert D. George



Picture above is our new Research and Development Center under construction in Woburn, Massachusetts. Scheduled for completion this year, the ultramodern laboratory will house the scientific and technical staff of the Avco Research and Advanced Development Division.

Avco's new research division now offers unusual and exciting career opportunities for exceptionally qualified and forward-looking scientists and engineers.

Write to Mr. R. M. Johnson, Director of Technical Resources, Avco Research and Advanced Development Division, 26 South Union Street, Lawrence, Massachusetts.

**AVCO**

Research & Advanced Development

## Washington Roundup

### Army and Industry

Army Ordnance, which includes the missile embryowards, has taken another step toward increased industry participation in its annual review of weapon development. Some contracts are being offered so that almost any contractor or qualified technical group in the U.S. can have access to the Army's criteria of its former weapons and equipment representatives. Making more people familiar with the Army's advanced planning is reported to make the plan more uniform and eventually provide better results.

Major Gen. J. E. Shaeffer, Chief of Ordnance, explained the new research procedure last week to a meeting of the American Society of Metals. He stated simply that their purpose is to create weapons design competition "for us." Such losses, he said, could help us solve "those men with vision as to how to solve an anticipated problem much more easily with the industry and assist us to carry it out and the industry is successful just at the time the problem becomes acute and very real."

### Senate Space Hearing

Senate Special Committee on Space and Astronautics is intended to begin hearings sometime on the Administration proposal to create a national space agency with the National Aeronautics Committee for Astronautics as its nucleus. James H. Donleavy, NACA chairman, will be the leadoff witness, according to Sen. Lyndon Johnson (D-Tex.), committee chairman.

The House Committee on Astronautics and Space Exploration is scheduled to conclude public hearings on the proposed NASA this week and go on executive session to wrap up the bill.

### Technology Act

Senate hearings on the proposed Science and Technology Act of 1958, which began last week, will be limited to consideration of a program for coordination of scientific and technical information. Sen. Hubert Humphrey (D-Minn.) chairman of the Senate Government Operations Committee said other provisions of the proposed act made coordination by the Committee on Astronautics and Space and will be deferred until a coordinated program can be satisfactorily worked out between the two committees.

Current phase of the hearings will try to develop information on the use of further legislation to enable the government to establish a program to ensure adequate dissemination of scientific and technical information.

### Small Business

Defense Department representatives have given Senate Small Business Committee, an optimistic picture of the possibility of substantial participation by small firms in the military market, nuclear and space programs subcontractors. But they anticipated a broad area from smaller than an prime contract. Perkins McGrath, Assistant Secretary of Defense for Supply and Logistics, reported that about 20% of the work will be prime vehicle contractors who have no small financial cushion between the first tier. Major Gen. Ben Park, deputy Air Force director of Ballistic Missiles, put the USAF percentage slightly higher and estimated that an additional 75% of the overall dollars for awards goes to second-tier small business subcontractors.

Aircraft Industries Association reported last week that of the \$1 billion paid in subcontractors of the aircraft industry engaged in defense work during 1957, more than \$187 million—approximately 21%—was paid out to small business subcontractors. AIA and the small business share of the total should be somewhat larger in industry moves into production phase of the program.

### Pay Increase

Both the House and Senate have approved "modest" increases per person—a flat dollar on the amount necessary to attract and retain a corps force. A modest increase has been approved in the last few days.

The House approved a measure that would provide \$681,000,000 annually to pay the military—the Senate's bill that would cost a total of \$537,000,000. The legislation was patterned after recommendations of the Concha Committee and is designed to keep trained and qualified personnel in the armed services. The bill provides basic increases for top officers and enlisted men and adds new grades to the present career structure.

### CAB Red Tape

This is in an effort to reduce Civil Aeronautics Board and type by eliminating non-essential hearings—for example on the purchase or loss of a small number of aircraft. Legislation authorizing the Board as the fire has been introduced by Sen. Warren Magnuson (D-Wash.), chairman of the Senate Commerce Committee, and Rep. Guy Harrington (D-N.Y.), chairman of the House Commerce Committee. Magnuson estimates that the legislation could eliminate 100 to 150 hearings each year which are now required to be conducted at considerable expense in terms of time, effort and money expended by the Board's staff and by the applicants.

### National Air Museum

Proposed to create a National Air Museum in Washington as expected to be completed in executive session within the near future. In the Senate Public Works Standing and Committee Subcommittees. According to Chairman Sen. Fred McKenzies (D-Mich.), public hearings have already been held.

### Airport Design

Civil Aeronautics Administration last week named the firm of Associates and Writers, New York, engineering consultants, to design the new Washington International Airport at Chantilly, Va.

Bennett Greene, recently retired director of the Washington International Airport, has been appointed special advisor to the executive management program of the Miami International Airport. Cofield will be associated with Howard Needles Tammen and Brundage, Miami's engineering consulting retained by the Miami Port Authority.

The new Washington terminal building, control tower and service buildings will be designed by Gensler Associates, Miami, and McDonnell of Kansas City will design electrical installations at the new Washington airport and Elgin Hospital of Washington will be the main planning consultant.

—Washington staff

# Man's Scientific Role in Space Debated

**Panel at AFOSR astrophysics symposium questions whether man will be useful or merely "add noise."**

Debate—Question of whether man would be a useful scientific observer in space or merely "add noise to the system and degrade the data" started a sharp controversy at the second annual Air Force Office of Scientific Research Astrophysics Symposium here last week.

A seven-panel discussion the question and generally agreed that certain aspects can do the job better than man, but the bulk of the delegates at the well-attended session exhibited a strong disagreement with that negative view of the situation.

Title of the discussion was "Is man a capability for manned space operations—for what purpose should that capability be reduced?"

This was somewhat misleading for two reasons:

- **Panelists were specifically prohibited from considering application of man to manned space flight.**
- Military security obviously prevented panelists from discussing their own knowledge of existing flight characteristics and devices that would provide the feasibility of manned space flight.

## Sphinn's Summaries

Aflectron F. Sphinn, director of the University of Minnesota's Institute of Technology, summed up the panel's findings this way:

"None of us here is arguing against manned space flight. What we are arguing against is doing it under the cloud that it will provide useful scientific information."

Approximately 1,000 delegates attended the two-day symposium, which was composed of the Directorate of Astronautical Sciences and organized by Dr. Morton Alperin, Head of the Directorate of Advanced Studies of Air Research and Development Command's Air Force Office of Scientific Research, and Col Paul H. Dill, then chairman of the Rocky Mountain Chapter of IEEE and professor of thermodynamics at the Air Force Academy.

Col. Paul Campbell, AFOSR flight surgeon who was chairman of the discussion of man's potential as a useful space observer, and USAF astronauit candidate Fred W. Haise, a test pilot for a flight test organization, were the panelists in the space laboratory in just as essential as it is in an earth laboratory," he said.

"He can at the same time be the

and leading problem are solved. Unsettled exploration becomes a race now only because there are no ways that the use can use and accept man, efficiently directly."

There is a parallel to this in the investigation of the oceans," Sphinn said.

"The oceans have generally been explored by fishing, sonar, bathy, and with instruments in long lines. The idea in the oceans has been sampled by nets and trawls, sometimes going as deep as six miles from the surface."

"The best hope appears to trying to understand the ecology on the land and in the oceans," he said. "Failure of science and other animals and plants in a long zone from a helicopter flying at the height of Mount Everest."

With these exceptions, however, untrained instrumented robots will continue to be more economical to use than manned vehicles," Sphinn declared.

Prelat Fred L. Whipple, director of the Smithsonian Astrophysical Observatory, and others' program in space will be to help eliminate the need for man in space.

"Man can be needed, for example, to adjust telescopes, to spatially coordinate the instruments, and to 'tend' them, while the robots grow around him," he said. "What is needed is a robot that can grow around him." It grows out of his history, the record on the growth of plants," he continued.

## Cell Satellite Applications

Whipple also listed 10 potential uses for man-in-space vehicles:

- Environmental instruments, including magnetic fields, air density, cosmic radiation, etc., in present satellites
- Radar and laboratories of the type Col Campbell described
- Laboratories for performing physical experiments. "Dissolvability" is probably the only exception where weightlessness is an important factor.
- Astronomical observations. "To see what collecting galaxies look like" and to make the same maps spectra.
- Meteorological observations. These would be much to bring the greatest advances in earth, Whipple said.
- Space communications vehicles, including communications relays. "There can supply the entire earth with space optical," Whipple said.
- Navigation satellites. With electronic motion in stable orbits and formative in the near future, navigation probably can be handled better in space orbit, he said.

Whipple said:

## Space Coverage

Second Annual Astrophysics Conference sponsored by the Air Force Office of Scientific Research at Denver was concerned with a special Astrodyn Week organized from including Robert Bales, editor, Irving Stone, Los Angeles Times staff, and Everett Clark, space technology editor.

• "Way stations," in space stations or living stations, such as the earth from which long flights could be launched and return to the planet. "Whipple said.

• **Manned satellites.** These will undoubtedly be some instruments which can be helped by weightlessness, although the zones with one-tenth the earth's gravity, might be a better compromise.

• Unmanned in space. This possibility could lead even to "Space Superdome live," Whipple said. He said he uses term will be "useful and impressive for us" in planetary exploration George Giuricic, of the University of Colorado, said that, although he does not expect that man can go to Mars, he may be able to go to Mars and be different than anyone ever before—more interesting. All life as such is built around 2D "left-handed" amino acids, yet enzymes can produce large amounts of alpha acids in the laboratory.

## Planetary Life

Man might find that life elsewhere is built on odds ratios than the 70 that appear on earth life or the planetary odds might be the same goals found here, but he "right-handed," producing unsymmetrical and enantiomeric forms of life, Giuricic said.

Dr. William E. Pickering, director of California Institute of Technology's Jet Propulsion Laboratory, and that the capability for manned space flight becomes much more when we consider the exploration of other planets.

Before that comes, unmanned vehicles can accomplish almost all of the missions assigned to space flight is a change and new vehicle function. "It was Dr. Pickering's paper that constituted the communiquants engineers' plan that was right only 'told man to lose interest' in space exploration of other planets."

Before that comes, unmanned vehicles can accomplish almost all of the missions assigned to space flight is a change and new vehicle function. "It was Dr. Pickering's paper that constituted the communiquants engineers' plan that was right only 'told man to lose interest' in space exploration of other planets."

Only satellite applications involving human passengers, Pickering said, is it just that passengers going along for the ride can be the earth's first new citizens to travel across the globe in a few minutes, to have the role of a real hero after space."

Paul Basciano, president of Paul Basciano Associates, and photo mapping of the earth from satellites will not be feasible for some time—unless classified, off-the-shelf equipment—because of the great size of the equipment needed to get the degree of resolution was obtained by himself. But he said current techniques and equipments are already adequate for the initial exploration of the moon and planets and for some time to come, until man is made available for long duration when vehicles can be used.

Paul H. J. Stine, of Cal Tech's Jet Propulsion Laboratory, called for a "nimbly balanced" manned space program "unencumbered by the mass of political conflict."

## Earthbound Sentiments on Space

Denver-Space enthusiast comments about space flight expressed at the second Annual Astrophysics Symposium here last week:

• "The Feynman offered 20% of their national potential for 20 years to build the Great Project. If we applied the same percentage of national effort for the same time, we would put the pants onto it. I want to go so strong that I can see advancing it."—Dr. Fred Whipple, director of the Smithsonian Astrophysical Observatory.

• "I quite seriously will go into space before for a quick study, because there is no room there for failure. We might get a nice little space lab, we get a nice lab because we would have trouble with the Human Society."—Aphelion E. Lyman, University of Minnesota.

• "The prime major lack of present public support. The space program is from a marketing firms second only to sex in power."—Dr. Clifford C. Fauset, chairman of the University of Buffalo.

• On the likelihood that strategic materials might be found on the moon and reported back to earth. "We made an economic study of it, I think it would not pay even to bring huge demands back from the moon. Only if there are minerals that are not available on earth would be worthwhile and I do not think that likely."—H. J. Steiner, Jet Propulsion Laboratory, California Institute of Technology.

• One member of a panel discussing how the capability for manned space flight should be utilized if and when it is achieved, suggested that "if we put men into space, perhaps we should put women there, too." Another panelist replied: "The has already been studied under the heading of comparative therapy."

"It would easily be possible to fall into an extreme position where an excess of effort applied to immediately explore the moon would make it difficult to proceed to the following, and so on, so forth," as an example of what might be lost in the organizing problems of the following step it could make it necessary to lose those interesting scientific results which could be achieved by a more happy distribution of effort." Steiner said.

Other panelists suggested in passing that delegations included a "gravitational satellite laboratory" and a "radio-astronomy" radio telescope in space, possibly L3000 ft. to one-half mile to space.

At his usual future Col. Campbell concluded that "men will come due go into space . . . and we will find uses for them that we do not understand now. You cannot stop him at home."

## IONIC PROPULSION

Techniques and equipment leading to space exploration were discussed in the following technical papers:

• Thrust predictions and related data associated with space propulsion were analyzed by David R. Littmann, director of the Electron Beam Research Laboratory, Raytheon-Wickliffe Corp. Broad qualifications included a thrust that effectively can be zero and will be less than total zero power rating over some time other than by radiators (trapped moment), preflight and postflight, to others than of heat, change beam current, and so forth, with high performance and that a total strength of 40,000 rps per centimeter required in high current mode can give deflection in low current mode.

• Paul H. J. Stine, of Cal Tech's Jet Propulsion Laboratory, called for a "nimbly balanced" manned space program "unencumbered by the mass of political conflict."

## PLASMA ROCKETS

Analysis of propulsion by plasma rockets of fully ionized plasma was made by Dr. Richard M. Peticolas, senior research, Air Force Research Laboratory, Air Force Materials Group. In this scheme, plasma is accelerated by magnetic pressure. Advantage of the process over the electrostatic method is

that separation of ions is needed, with energetic plasma being neutral, while in ion rocket accelerates a charged mass.

Rocket producing acceleration is used to meet three requirements for electro-magnetic acceleration of a gas:

- Production of uniformly spaced gas in the initial stages of acceleration process to provide uniform current in the gas
- Compensation of gas single-labeled shock wave to eliminate losses to walls
- Acceleration over relatively long distances to provide enough force to a strong magnetic field to build up to the required launching velocity.

Many problems of flight of magnetic fielded gases is made up of the sum of the properties foreseen by the discharge circuit. Patrick pointed out Calculations indicate that a magnetic fielded motor would have similar performance characteristics to an ion rocket motor proposed by Dr. Ernst Stuhlinger (See tip to Man), when operating at conditions where exhaust velocity is 120 km per sec.

#### Thrust experiments

Performance thrust experiments supported by a number of experimental and analytical research predictions that the plasma rocket can be one of the most practical propulsion systems for space vehicles, according to D. F. Howard, General Research Laboratories. Although experiments have been made on small models, it has been shown conclusively that maximum high specific impulse can be obtained with an electric arc plasma generator. Howard pointed out that it is reasonable to expect the results of further experiments will produce three to five times the specific impulse already measured. Specific impulse of one sec has been obtained with argon, exhausting to atmosphere.

Commenting on thermal-weight ratios, Howard declared that it is highly doubtful that a plasma rocket will ever lift more than the surface of the earth. He said it is reasonable to expect that when it is possible which tasks the type of propellant of interest in certain specific applications, organizing and behavior of switches.

#### ROCKET COMPARISONS

Nuclear rocket appears most suitable and reliable for space travel, according to T. G. Lee and K. P. Conner, of Aerojet-General Corp. Inherent thermal stability of the nuclear rocket, coupled with extremely large specific thrust makes it ideal for a nuclear propellant system capable of a constant, high-power propulsive system for supplying multistage reentry.

In general, chemical rockets using carbon solid or liquid propellants are not suitable for propulsion in space, but in certain specific cases a propellant system using solid propellants is a good feasible and may represent the most reliable system.

Proposed ion-propulsion systems should utilize planar electrodes as one of their energy stores, it was indicated.

Investigations show that a resonance engine can withstand higher and more intense levels of thrust per unit frontal area and engine specific thrust.

Successful utilization of ions for propulsion would result in improvement in specific impulse of an order of magnitude greater than that achievable from chemical propellants, nuclear rocket and thermonuclear engines, Lee and Conner indicated. To obtain a potential system of high specific impulse, a team of engineers from aerospace industries and aerospace research organizations were to resolve that pointed out. Performance calculations based on present knowledge show that actuator systems of an ion-propulsion system at the rate of one-millionth G.

Construction of initial and smaller types of guidance undoubtedly will prove to be the most important if not the only means of guiding the space vehicle in interplanetary travel, Lee and Conner said, at least in the initial phases of the flight regime.

#### MARS PHOTO-RECON

Technical feasibility of a five-year, continuous photo-reconnaissance round trip to Mars was analyzed by J. Balcombe Jr., Elmer J. Frey and Milton B. Taggart, Massachusetts Institute of Technology's Instrumentation Laboratory.

A six-month development program was suggested, they said, a vehicle could be launched within five years to seven years. Well-balanced, only guided vehicle design based on known techniques should permit the mission to be accomplished with a reasonable probability of success.

Basic problem of navigation would be handled with a sun-tracking telescope and another telescope to track stars and planets.

Rotating vanes would form a gross mechanism to put the sun-telescope on target and keep it there. Single sun-gazing would keep the vehicle sufficiently lighted.

Using the sun's own until the star-vane separates the target. Feedback through a microcomputer and a pulse digital computer would allow the computer to control the vehicle's attitude through use of the feedback. Oscillating rods also would be controlled in part by solar power and a lower power propulsion system for supplying multistage reentry.

Viewing telescope with mirror as reflector would have a 5-in aperture, 20-in focal length, and would see an 18-mm-dia Sun. System would give 950-ft resolution at a distance of 4,000 mi.

Rotated vane of the vehicle and low-thrust vehicle, such as a spin-pumped rocket ship, as mentioned in Mars, was compared by J. H. Irving and E. K. Hall, Space Technology Lab, Hughes. Keen-Woodlidge Corp.

Both vehicles start from 180 mi circular orbit about earth, with low-thrust vehicle being boosted into orbital orbit. Ballistic vehicle starts to Mars in an ellipse which depends on how often it has to fire. Low-thrust vehicle, powered all the way, can escape from earth on a spiral orbit, then follow an elliptical transfer orbit to Mars. Mars is the second innermost planet of the solar system.

Each vehicle carries an atomic reactor. We start about Mars. On returning to earth, thrust reduces reentry speed to earth's escape velocity. Re-entry is accomplished using aerodynamic deceleration.

For the same travel time, low-thrust vehicle having power supply weighing between 100 and 200 kilograms per kilowatt of useful power at least a quarter of the weight of the vehicle to be accelerated.

Consequently, propellant-hauling vehicles have about twice the weight of the power supply. Weight differences 30 and 70 kilograms per kilowatt, performance is about equal to that of ballistic vehicles using aerobraking heated by nuclear reactors.

If the weight of power supply can be reduced to one to 10 kilograms per kilowatt, payloads of over 50% of the total weight can be carried even on roundtrips to Mars, taking only four to six months total travel time, Irving and Hallwood concluded.

#### SPACE BOOSTERS

Launching of space vehicles by air-breathing lifting wings was outlined by Antonio Ferri, Polytechnic Institute of Brooklyn, and Lewis Friedman and Walter Shatkin, Grant Applied Science Laboratories Inc. By using lifting airplane as first stage of satellite launching system, flight requirement can be reduced, and since lift reacts right in atmosphere, propulsion by air breathing engine is required. Advantages for launching are:

- Specific impulse is increased by an order of magnitude
- Flexible launching site is afforded

large fixed and expensive ground installations are eliminated.

• First stage is accessible and versatile in repetitive operations such as launching a cluster of satellites with one modification, and an launching space stations.

• First stage reusable is important and reduces payload cost.

• Reliability is high.

It will be possible to launch a 10,000-lb payload—7,500 lb payload plus 2,500 lb of fuel—using sonic-boom-free, non-thrusting methods.

Conventional air-launched systems would have somewhat higher initial weight than the air-breathing arrangement and would require much larger aircrafts with thrust of about 1,000,000 lb.

Much mass can be put into orbit in a given rocket currently substantially with launch Mass number. As launch speed is increased beyond Mach 5, no flame disadvantage outweighs the disadvantages of large rocket engines.

Turbine operation with 100 hr unrefueled for speeds up to Mach 4 and dual cycle engines were used at Mach 4 and Mach 6, both to sustain a single and hydrogen fuel at Mach 2.75.

#### RE-ENTRY

Differences between satellite and bolide return orbits, or even were pointed out by Fredric Radbill and J. D. Tracy, of Aero Manufacturing Corp.'s Research Laboratory Division. Satellite, in general, experiences much lower deceleration, hence both deceleration and heating time occur over an order of magnitude longer than for a bolide reentry.

Also the significant heating occurs at higher altitudes for re-entering satellite.



Republic Displays Nose Cones

Nose cones on display at Republic Aviation Corp., where they are produced under subcontract from General Electric Co., are destined for use in the Thor IRBM. Cone itself is cast at right and is the only part that actually shows on complete missile. Standoff at the left is the aftbody. Unit in the center (part behind nozzle) of Thor and Atlas is enhanced cover. The nose-cone assembly will be used on the Afar.

#### Navy Chooses Electra

Lockheed Electra turboprop aircraft has been selected by U.S. Navy for use in its anti-submarine warfare program, after evaluation of "several" other aircrafts.

Navy and a research and development contract with Lockheed Aircraft Corp. will be completed shortly for a modified model and further test flights.

Electra will carry a crew of 16 men and considerable electronic instruments and film. Electra, which will replace Lockheed L-188 Electra, is powered by four Allison T56 turboprop engines each developing 4,000 hp (ANW Min. Sl. p. 44).

Contractors above highlighted in a variety proportional to square of distance to nation.

#### LUNAR PROBLEMS

Scientific and engineering lunar problems were outlined by Dr. John L. Barnes, Systems Group of Avco. Present lunar trajectories require a large payload and sizable value of liquid oxygen. Their present value with its cost of fuel and payload assumed (Table I) provides a minimum cost of \$100 million for a lunar module.

Reducing the cost of launching the module from a lunar module could be realized through 100% use of telephones to supply data. To pack up light of explosive on the moon's surface through the telescope, a matrix of photoelectric cells with individual conductors might be used as a detector. Electrostatic light collected from lunar surface in dust collected with thin film increases its light intensity are measured and swapped off film carried by the telescope at the particular band.

Additional fuel for long return trips may be provided by vehicles. Duster, and solar cells could measure the moon's relative surface velocity and distance. Also, pairs of laser altimeters could take telephone or television pictures of such other with background of aerial bodies to provide reference grid.

Other measurements Barnes suggested included the moon's magnetic field, existence of atmospheric distinct from rest of solar "atmosphere," at traces in the moon's gravitational field together with determination of orientation, density, and temperature of the atmosphere near the moon's mean orbital position, its pressure and temperature.

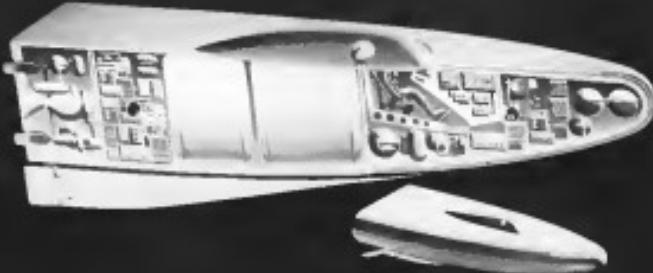
Among last engineering questions which will be partially answered by this explosion are best location for landing instrument-carrying vehicles, landing and takeoff of extended observatories, and normal and maximum accelerations of jet propelled. Other answers would be best means of solar and oxygen heating rocks, wasted materials, and lunar mud materials.



#### SPACE TECHNOLOGY

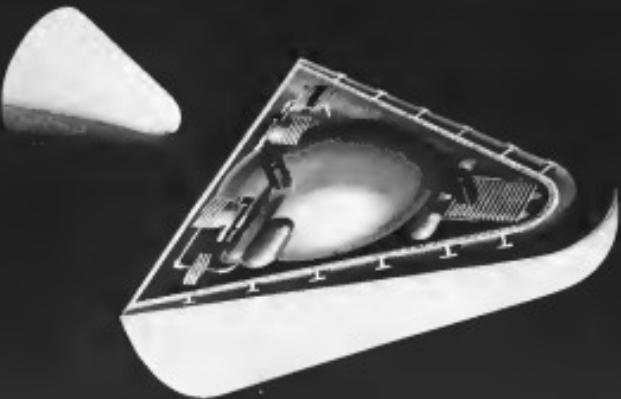
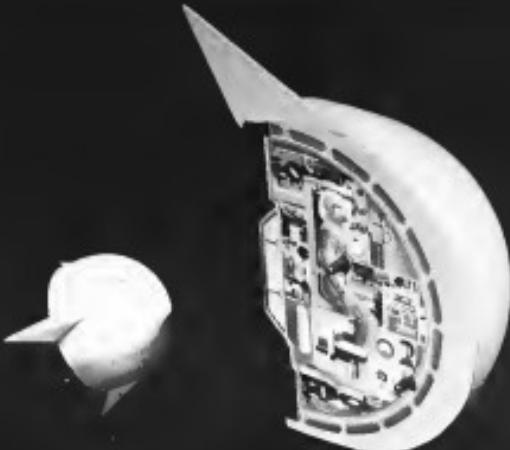
## NACA Proposes Satellites Capable of Piloted Re-entry

National Advisory Committee for Aeronautics delta-wing satellite proposal (above left) would have blunt nose and blunt, highly swept wing and no leading edge to reduce aerodynamic heating. It would land safely conversely compared with present heat insulation methods, which require a high probability of impact at high angle of incidence. (Other heat shield land on water.) Delta wing would be subjected to severe heating, especially at nose and wing leading edges. Bell's reentry would have controls for maneuvering during reentry and landing, would orient at high angle of attack,



and would be radiation-cooled. Recovery stage rocket motor is under load, enables in delta wing, give fast stage boost to satellite speed, small retrorockets inflate reentry. Recovery jets for space stabilization, carbon composite are located for two atmospheric reentry stages. Total orbit conversion periods since recovery rockets do not exceed 20 sec. Horizontal reentry (below left) has heat shield of expanded aluminum and heat sink design. Heat sink exits outer shell it is supported from inner capsule, which is heat-insulated by insulation. Heat sinks

180 deg. normally as pilot can adjust coil to meet minimum bidirectional forces. Internal equipment includes search and flight instrumentation and obscuring gear. Recovery chute is vehicle's base or for low speeds has strakes. Retractable in atmospheric entry, but not in reentry. Recovery gear deployed during reentry (below right) has copper shell heat shield that is discarded at nose. All gear and insulation insulate shell from outer capsule. Parachute is inserted sufficiently far forward in capsule to receive stability of results during atmospheric reentry.









**first... plane to land at the South Pole  
place... Operation Deepfreeze II  
heater... Herman Nelson, of course**

The first aircraft ever to land at the South Pole—and the first Americans to set foot at the South Pole...these were history-making feats achieved by Operation Deepfreeze II. The mission was carried out on October 31, 1966, by a party of seven men in this Navy R&D. Naturally, Herman Nelson Portable Heaters were chosen as support equipment for this important mission, providing quick, unfailing heat. Herman Nelson's 14 years of experience in the portable heating and ventilating field can be put to work on your problem.

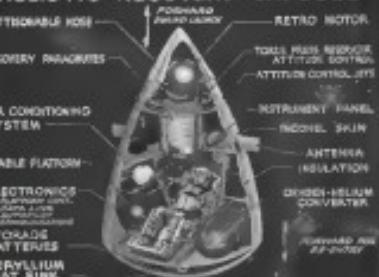


**American Air Filter**

COMPANY, INC., 3rd St. & 3rd Ave., Brooklyn, N.Y.  
DEFENSE PRODUCTS DIVISION

SEEKING THE DEFENSE ESTABLISHMENT EVERYWHERE

## BALLISTIC RECOVERY CAPSULE



NORTHROP's proposal for a recoverable manned space laboratory would be housed in a bullet-shaped capsule 7 ft. dia. and 30 ft. long, to be launched by existing ICBM.

## Manned Space Laboratory Plan Based on Bullet-Shaped Capsule

Los Angeles-Northrop Aircraft's plan for a recoverable manned space laboratory, which would be put into a 200 to 300 mi. altitude orbit where three astronauts could live, has just reached the pre-proposal stage. George Douglas, vice president and general manager of Northrop Division, and company has developed basic design criteria for a perfectly feasible manned space laboratory.

Bullet-shaped capsule approximately 7 ft. dia. and 10 ft. long with wings strapped onto its sides, would be boosted by existing intercontinental ballistic missile coupled with a Polaris for additional stage. Capsule would weigh about one ton and would have a service life of approximately 1,000 hrs. Main module capsule would be in a more reducing position to withstand forces of acceleration and deceleration required for air conditioning, communications, navigation, vibration, environmental data, and all other functions necessary for the trip. All are included in capsule.

None of capsule contains reverse thrust rocket to be fired at a point about 100 deg from desired landing spot, would change capsule attitude so it would land on blunt end. During launch, pointed end of capsule would be removed to reduce drag and would also serve to keep capsule from being struck by static acceleration forces from front to back. After obtaining orbit, capsule would make several revolutions until

solve (about 2 deg), keeping heating into and dissipation at acceptable levels. High drag in blunt end forward attitude would drag capsule from 25,000 fpm to 1,000 fpm (March 31) in the time it had descended to 60,000 ft altitude. Capsule parachute would open at 30,000 to 30,000 ft to ensure gentle landing.

Northrop feels that use of the most critical guidance and control systems of vehicle to be used. Return flight to Earth may need to be controlled very accurately as well as velocity at end of return flight, direction of thrust and timing to ensure return to desired area as much as those of a ballistic missile, namely minimum heating and deceleration. However, Northrop feels that by re-entering at low angle with high drag shape it can limit the maximum surface temperature to about 1,320° and deceleration to about 10 G. Ten percent inside capsule would rise with slightly since insulation would overheat during reentry and won't be able to insulate.

Return program would include unassisted flight prior to launching man-without instrumentation and then with sensors.

Northrop's Advanced Design Department is active on several space projects, according to Douglas. Company has conducted numerous studies in field of astrophysics and has surveyed existing knowledge and proposed theories in this field over the past 24 yr.

Douglas explained that unassisted return program is proposed as a test early stage before specific scientific vehicles can be developed for man under pressure. The objective is to accomplish simultaneous operation of scientific and laser stations for energy beaming and communication must not be disrupted once beam comes from the development of today's aircraft and man.

## Computing Center Gets Equipment

Full complement of automated subroutines required for bare bones model for Northrop's Computing and Defense Center Computer, which announcement was made of the company's studies leading to the rapidly

Another equipment capable of simulation and model testing is provided as well as analog circuitry, digital calculators and data loading.

Another part of Computer is devoted to studies of new methods and machinery which will further computation, data handling and calculations.

Computer currently operates an IBM 704 digital computer, plans to install an IBM 709 at the future.

## British to Order Additional P.1Bs

Additional production order for the supersonic English Electric P.1B fighter and a trainer version will be placed "as necessary to cover contracts of purchase," British Minister of Supply Affairs Jones told Parliament.

Estimation of the total number of additional airplanes to be built depends on the quantity of about 150 including both types.

The new trainer has a safety role in the event of a possible emergency as an all-weather fighter in case of last-minute replacement rates not attainable operation. Aircraft is scheduled to fly early in 1969.

# Opposition Grows to Reorganization Plan

By Robert H. Cook

Washington—Congressional opposition to President Eisenhower's controversial proposal for reorganization of the Defense Department intensified yesterday when the Senate Select Committee on Small Business altered the bill in line with views expressed by the House Armed Services Committee.

Congressmen know that the Administration might "bend a little," resulted from testimony by Secretary of Defense Neil H. McElroy who said he was not "wedded" to the language of the proposal. Admitting that he would have preferred some words in other forms, he claimed, "I am fully cognizant involved with the plan. We may say 'there is an opportunity here for a good deal of mutual working out of language.'

The President, however, has twice assured that there will be "no retreat from our basic compromise" in the essential parts of his bill.

Opposition to the Administration plan is following a line of attack that, if adopted, would place the future of the nation in the hands of a "military cast" and a "President type" general staff. Congressmen made around sections that expand the powers of the Secretary of Defense and increase the size of the existing Joint Chiefs of Staff.

Congressmen also fear that the present wording of the bill might eventually be interpreted to bring about a possible merger, or even elimination, of service branches under the guise of unified commands.

Senate Majority Leader George A. Smathers, chairman of the Joint Chiefs of Staff, Gen. Maxwell D. Taylor, Army chief of staff, and Adm. Arleigh A. Burke, chief of naval operations, have studiously avoided these allegations in the face of a battery of questions.

Supporting the plan, Adm. Burke maintained against allowing the Joint Chiefs to become involved in too much detail which might result in "confusion of responsibilities." He added that he found nothing in it that ran counter to "common sense."

Opposition to the proposal was expressed in a letter from H. Wayne Kehoe, former chief counsel for the Defense Department.

Tonight the plan "180 degrees opposite" of reorganization moves by the President in this case, the attorney wrote. Congressman George Carl Vesey (D-La.) that "I cannot believe" that the basic pattern of the Administration's present bill was "overly thought through."

Kehoe charged that the "major element of the plan lies in the creation of two

parallel chains of command—one for operations and one for support."

He said the President's 1953 plan was based on the idea of the joint Chiefs as the primary liaison with the Defense Secretary during discussions through the civilian ministers of the Army, Navy and Air Force. The plan now being offered places responsibility for command functions, as well as planning, within the Joint Chiefs under the supervision of the Secretary of Defense.

Senators Tamm and Taylor both challenged charges that a "President" general staff would be created by expanding the present Joint Chiefs of Staff. Gen. Tamm said that many staff functions which the services are accustomed to performing are already being handled by the Joint Chiefs. He said the President's proposed plan creates a sort of shadowing of the Air Force that two people won't be doing the same thing

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# Unexpected Cosmic Radiation Could Raise Space Flight Problem

Washington—Unprecedented intense cosmic radiation of uncalculated nature which could raise serious problems for manned space flight was extended periods has been observed at altitudes above 62,000 ft, as data obtained from Explorer I and III indicate.

This in use of preliminary findings revealed last week in the first official report on analysis of data obtained from the two U.S. International Geophysical Year satellites.

The report was made to members of National Academy of Sciences and American Physical Society.

Telecasted data received from Explorer number three showed Explorer I and III suggest that cosmic rays consist of 30-40 per cent protons and 200-300 Mev, ultrarelativistic nuclei, 15,000 per sec at altitudes above 1,000 m. Data taken thus far have been unable to determine whether the radiation results from particles bombarded from space or from X-rays generated by the interstellar solar electron background.

If the high energy rate results from X-ray radiation, it would be the ultrarelativistic electrons that are most effective because they penetrate the atmosphere more readily. This indicates that humans in space vehicles at altitudes between 62,000 ft and 100,000 ft would receive a dose equivalent to living near ground level.

The concern here is that Lockheed engineers are employing the measure as a selling point to attract business. Because of this they consider Lockheed offers far less than that obtained from Republic.

In its most recent proposal the company has offered a rate graduated from \$100 per hour per person without upper limit. Republic, on the other hand, offers a rate for the first 100 hours in addition to the cost of living plus.

IAW and USAF call the proposal "unfair, unrealistic and unacceptable." Original union report for a graduated 60% increase has run up to 42%, which would average down to 10 cents per hour. Smaller firms that cannot sell aspect are proposed which gives the higher portion of insurance premium and adiabatic rates. Adiabatic rates reflect the use of that air rate offered.

He claims that Lockheed intends to negotiate a price base by grandfathering job rates and then to lower the labor group distinction of certain jobs. The idea is also depositing that if an employee is transferred to another division, he cannot use his remaining seniority to return to the first division and benefit his replacement.

He suggested that the nature of new mission might be determined by averaging the amount of atmospheric insulation, light and radio noise per day.

Highlights of reports by other

contractors on welfare findings to date include:

- Explorer I lifetime is now estimated at three to five years.

- Atmosphere density at 230 mil. is about 620 per cu mil, data obtained from Explorer I and III indicate.

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## News Digest

### West Coast Strike Threat Grows; Labor Aims at Busiest Companies

Los Angeles—Strike action of some sort is now considered likely in the West Coast aviation industry, labor dispute over plant representation having shown no broad breakthrough but that intervention of this sort would be "inevitable."

McGraw told *Aerospace Weekly* that the Department of Defense decision to hold resistance to labor demands to a CIO-Centinel would make damage to aerospace unlikely before the end of the year. An aircraft spokesman said that negotiations between the two sides had reached impasse, and that the CIO had decided to present a solid front against labor. Selections which would minimize the likelihood of Presidential intervention on grounds of their adverse welfare effects such action would probably be made as soon as the board meets.

McGraw and Douglas North American and Convair have made no "concrete" proposals and have broken off talks to avoid the nations of negotiations at Lockheed. He charged that Lockheed's offer of a 10% pay increase, though a modest one, is the best alternative to further aggression toward labor.

Retirement and possible change to another after a year time are achievable factors which could start up again both sides. Los Angeles of IAW and A.C. McGuire of IAM, heading joint board of strategy, charge the Department of Defense with being "the ghost at the beginning table."

Boeing and Department of Defense have issued a directive giving training plant representatives authority to veto reimbursement of a company for additional costs due to new labor contract and in advising them to use it.

Both sides are awaiting the outcome of the negotiations between the two unions over plant representation. The CIO has broad jurisdiction but that intervention of this sort would be "inevitable."

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# Airlines May Face Military Traffic Loss

**Defense officials foresee diversion of traffic if examiner's proposal to drop discount is approved.**

By L. L. Doty

Washington—Strong possibility that airlines face a cutback in military traffic next fall work by a Civil Aeronautics Board examiner's initial decision opposing continuation of the 10% fare discount on military transportation.

Assumption of the discount is underscored by the fact that the Defense Department is now the largest single source of military airfares available to the scheduled airlines.

Last year, consolidated airlines grossed approximately \$63 million from military fares, or about 95% of the total domestic military passenger travel market.

## Defense Stand

However, Defense Department officials contended by Airlines' White House liaison committee that their programs which present military programs within the department could force the adoption of more traffic fees from the airlines if the existing 10% discount on military airfares were removed.

The stand was further widened by Vice Chairman George H. Jones, former Judge Advocate General, who testified on March 11 before the Civil Rights of the Armed Forces Committee that discontinuance of the agreement (10% discount on military airfares) will unquestionably result in the diversion of an undetermined amount of military air travel by the military agencies to other sources of transportation.

In his final decision, the Board's hearing examiner, Edward T. Shultz, concluded that the discounted and equalized fares granted to military passengers are "legitimate transportation" and "allowable." Explanations focus a sound predicate granted by the airlines to only official military travelers, provided that if a fare is a discount resulting in either 10% of the fare or a flat rate, the military traveler will pay the discount fare.

Both sides have been a source of controversy within the airline industry for the past six months. The defense side came into the open last fall during an Airline Conference meeting in New Orleans when American Airlines announced its opposition to both the discount and fare equalization. Even fairly senior carriers such as American's and Pan Am had endorsed the two fare prefer-

ence fares than fares charged for military traffic.

However, a threatened loss of traffic to those carriers still offering the discount forced the discount airlines to reverse their decision within 21 days and to assume the discount and equalized fare practices.

Prior to the reversal, Maj. Gen. E. C. Lasker, then executive director of the Military Traffic Management Agency, told the Civil Aeronautics Board that the interests of economy in large degree determined use of the discounting carrier. He said that this would have the effect of "reducing overall travel costs of carriers without passing those savings to the traditional discount."

## Delta's Brief

In its brief to the Board, Delta Air Lines said the "growth in military traffic [per unit] can be attributed almost entirely to the granting of the 10% discount and the elimination of the preference clause in the contract agreement."

In explaining how the airlines can afford to absorb the discount without seriously affecting revenue, Delta had this to say:

\* **Expenditure cuts** for military traffic are cheaper. One cell will complete construction for 10 to 12 people traveling on military basis, while other traffic must be handled individually.

\* **Fueling costs** are less for military traffic. Block of tickets can be purchased at advance before rail roads start ticket issuance and military passengers can be checked in at airports in groups rather than individually.

\* **Cost of sales** is less for military traffic. Delta said that as of December, 1957, a city ticket cost \$1.00 more than a military ticket. GAO/DOA in a recent proposed \$200-million airfare base-line. Ratio of ticket office costs in cities was 7.25% at the city ticket office and 1.97% at the JANTMO.

\* **Average length** of haul of military passengers is about twice that of non military passengers. Domestic civilian passengers average about 315 miles as compared with the military passengers' average of 650 miles. Delta and a 50-passenger DC-7 at first-class fares will never fully allocate seats with 30 passengers on a trip of 1,000 miles but that the same DC-7 will require 32 passengers to break even on a 900-mile trip.

\* **Advertising costs** per military passenger are less.

In its stand against the discount, American Airlines said that it is in re-

view the so-called "preferential clause" in the various agreements with the railroads, which was noted as. This clause, which was in effect for 35 years, made it easier for the railroads to get rates for transportation of personnel with no time limited exception.

Airlines supporting the 10% discount maintain that a strong threat to airline business lies in Section 22 of the Interstate Commerce Act which authorizes fare reductions when transportation for person traveling for the U.S. government. These airlines contend that discontinuance of the discount will force military agencies to return to rail if only for economic reasons.

## Bell's Brief

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Johansen said military passengers incur the same amount of advertising expenses as other passengers. He explained that the American advertising program is "designed to make us all go places" and added: "Our purpose is to inform and to influence and that principle applies to all potential passengers."

Johansen said the discount was introduced as an "economics measure" and has been "approved" on a year-to-year basis. He pointed out that the discount cost Americans more than \$1 billion during the 12 months ending last Sept. 30.

## Air vs. Rail Trend

In discussing air fare that the airlines would lose traffic in the subway because of the elimination of the discount, American pointed out that schedule sequences of the rail cars did not change in the past few years as opposed to a steady improvement in airline schedules. Using 100 in 1948 as index, the American load and domestic railroad load plus index in 1956 was 155 while Class I first-class railroad car miles declined to 73 in the same year.

Available seat miles, the American load emphasized, showed similar trends. Airline available seat miles jumped from 31.2 million in 1949 to 231.7 million in 1956 while railroad available seat miles declined from 21 billion to 14.8 billion in the same period.

In his conclusion, Examiner Shultz found no basis for charges that air transportation should be the same to all passengers when the service is the same. He added that military passengers traveling under discounted or equalized fares receive the same transportation and services offered standard fare passengers on the same flight and that the airlines impose no restrictions on military travel that do not apply in civilian travel.

The Board found that, although the lack of equality of competitive airfares between military and civilian passengers can justify particular arrangements in the military services, this can also now be accomplished and the basis of competition should no longer continue as an excuse for fares which are obviously unfair.

Shultz also concluded that records fail to prove the airline industry will suffer a loss in military traffic in a result of the discontinuance of the discount.



IRISH AIR LINES' Super Constellation 86, Patrick is seen on landing at Dublin airport. Kish boat, right, and legs crossed under the aircraft.

## Irish Air Lines' Transatlantic Run Ties U.S., Off-line European Cities

By William H. Crowley

Dublin—Irish Air Lines, after five years as 1948 and 1952, began transatlantic service last week, flying in the fast four- to long-haul segment of the ultra-short-haul routes of an off-line expansion, Air Liners.

Expansion in the west has long been a primary goal for the state-owned Irish system. Now Ireland is at the center of its route complex instead of on the western fringe of it.

The Irish hope to gain those major advantages with the transatlantic flights:

- Increased military traffic from the U.S., benefiting Ireland's economy.
- More tourists. Last year 5,500 Americans visited Ireland largely by rail, arriving by air. That figure can be doubled in three or four years, the Irish Tourism Board believes.

• Traffic from Europe to load the long, fast long-haul route. The result, the Irish hope, will be to make Dublin a gateway to and from Europe.

As a competitor to the established transatlantic carriers on transatlantic New York-London or New York-Paris runs, Irish Air Lines would find it tough going.

But it has certain advantages in standout areas: the big eastern seaboard and, especially, the British Isles.

Likewise of Irish interest is U.S. tourism in one. The Irish Tourist Board, coordinating its efforts with Irish Air Lines, has opened offices in New York, Chicago and Boston to whet the desire

of these citizens to see the old country again and to add Ireland to tourist generally. As an indication of the progress of the campaign, Irish Air Lines had 1,000 bookings in the U.S. as of April 25, and new bookings were being made at a rate of 100 a day since then.

Another area is for tourists who want to visit Ireland first before going on to Great Britain or the Continent.

Still another in transporting European tourists off routes of other transatlantic carriers not served in Air Liners to the U.S. is off-line travel to and from the ports. Some examples:

• To Yugoslavia. Irish Air Lines which advertises the most direct service on that route, expects to double traffic this year because of the Cuban missile crisis.

Last year Air Liners carried only 5,500 scheduled and 1,000 charter passengers there. This year it has 9,000 scheduled bookings from Dublin and expects to have 12,000 scheduled passengers plus 10,000 charter passengers from Dublin or Boston, with 25,000 bookings already in hand.

• Birmingham-New York. This is another transatlantic simple because Irish Air Lines happened to pick up an unexpected transatlantic flight of 100 tourists who passed through the New York port of call during a special flight last week. They were a German tour group which had business in Birmingham and was invited to go on to New York.

This could be typical of many Air Liners points, such as Madrid, Malta, Athens, Damascus, Beirut—most major U.S. traffic points throughout





# AUXILIARY POWER for the U.S. Army's deadly NIKE HERCULES

AIRCRAFT-JET power the coverage of America's most potent defense weapons



Key defense and population centers are now being targeted with batteries of Army Nike Hercules missiles to deter or destroy aggression. Supplying power for flight control in the Aerospace Research Division just pictured above, now is problem.

As a member of the Aerospace team producing the Nike Hercules Army Defense Weapon, Electric Bell Telephone Laboratories and Garrett AiResearch Aerotests was chosen to design, develop and manufacture this vital auxiliary power source for the missile because of nearly two decades of experience in light-weight turbosuperchargers.

This expansion includes applications involving solid propellants, liquid mono-propellants, bi-propellants, rocket power, aerospace gas as well as ground and air. AiResearch's ability for high capacity production of aircraft engines and auxiliary power units is the key to their success.

Garrison's Aerotests division have also designed systems and components for 18 other missiles and rockets in the U.S. defense arsenal. We invite your inquiries.



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Systems, Packages and Components for AIRCRAFT, MISSILE, ELECTRONIC, NUCLEAR AND INDUSTRIAL APPLICATIONS

## SHORTLINES

► Alaska Airlines has placed its first Douglas DC-6A which the airline bought, renovated and is calling a DC-6C, in service on the Fairbanks-Seattle-Fairbanks route.

The aircraft will make round trips from Fairbanks to Anchorage before returning to Seattle.

► Canadian Pacific Airlines is scheduled to begin limited domestic 514 service from Vancouver to Anchorage on June 1. The recently delivered British can make the English-Vancouver flight in 16 hr., 35 min., with a fuel stop at Calgary, Alberta. Canadian Pacific has been authorized by the Canadian Air Transport Board to make a stop at the Arctic Air passenger and cargo air strip at its scheduled flight from Montreal to Lulana and Madeline.

► Handland Aircraft Co. Ltd. tested the first production model of the Comet IV last week on a flight around London. The company is scheduled to begin delivery of the Comet IV to British Overseas Airways Corp. in September.

► Hawaiian Airlines has completed the sale of \$1 million in debentures in the last phase of a financing program to cover the purchase of six new transport aircraft.

► Pan American World Airways has filed with the Civil Aeronautics Board for a statutory rate of \$145 between New York and Puerto Rico. If approved, the new fare would go into effect on May 22.

► Southern Airways reports a first quarter average passenger figure of 16,800, a 41% increase over the same period last year. Revenue passenger miles were up 52% over last year to 9,010,000 mi.

► Trans-Canada Airlines is scheduled to begin its Toronto-Montreal-Zurich service on May 17. In turn, Swissair is scheduled to start Zurich-to-Montreal flight the next day.

► United Air Lines reports first quarter 1958 revenues of \$66,343,912, a 10% increase over the same period last year. Operating expenses were \$56,773,376, leaving a profit of \$9,566,536. However, \$215,011 gained from the sale of surplus aircraft held the overall loss to \$34,933. Total revenue passenger miles for the period were 1,754,952,800, a 3% increase over the last quarter of 1957.

## AIRLINE OBSERVER

► Watch for a new route for Japan Air Lines from Tokyo to Los Angeles as addition to its present Tokyo-San Francisco route to emerge as the chief outcome of present talks in Tokyo on amendments to the U.S.-Japan bilateral agreement. An exchange for the route, contractor on the frequency of flight schedules of U.S. carriers into Tokyo probably will be used. Present thinking leans toward an unchartered number of flights without prior Japanese government approval, which is now required, with a provision that schedule frequency must not be less after a period of time if traffic does not justify the schedules.

► Northwest Airlines is transferring two Douglas DC-4Bs from its New York-Minneapolis to New England routes to handle summer traffic in the southern sector of the airline's system.

► Russian delivery of additional twin-engine Il-14s and single-engine An-2s will enable the Bulgarians since TABSO to increase traffic "substantially" in 1958, according to K. Kovac, Bulgarian's head of sales office. Kirilov and the carrier transported its manager and cargo goods in 1957 and returned to Bulgaria with more than 17%. Bulgarian airline TABSO expects an 18% increase in passenger carried last year and hopes to expand its international services in 1958 through negotiations with Czech and Egyp.

► American Airlines' target date for the first scheduled jet transcontinental nonstop service is Nov. 1.

► New York Airlines has made an agreement with Vinalco covering the transfer of the carrier's fleet of Sikorsky S-51s and S-51s for 60% Vinalco trademarks \$480. New York Airlines has taken on the responsibility of paying fees and related expenses will bring between \$1.1 million and \$1.2 million. "Stimulating sources of the net book value" of the aircraft.

► Pan American World Airways is preparing its plans for a resumption of the Transpacific Route Case. Latest efforts by the carrier for reconsideration brought the case back into the White House but there it has been stalled, at least temporarily, by lack of Presidential action.

► Civil Aeronautics Board has denied a request by California Air Charter, a supplemental carrier, to conduct revenue flights over Milwaukee-Wisconsin Air Lines' routes Salt Lake City and Los Angeles for the duration of the strike. The Board found that alternative sources of transportation are available to passengers who would otherwise use Wisconsin's services and that California Air Charter failed to back its petition by showing that a critical air emergency transportation situation exists.

► Air Transport Asia has petitioned the Civil Aeronautics Board for authority to build a network to dozen passenger fare discounts. Participating carriers would include only those involved in the particular discount under discussions such as family plus, student fares, children fares and open price rates. ATA is using nation-wide standards to discount plane to eliminate inconsistency to passengers, complicated ticketing procedures and unnecessary costs.

► Chicago Midway Airlines has received authority to expand its scheduled passenger service to include Winona, Ill.; Gary, Ind.; Peoria passenger service is confined to the Chicago route between O'Hare Field, Midway Airport and the Chicago Loop.

► Civil Aeronautics Administration's accelerated drive toward positive control of air traffic is a key step in the reduction of the mid-air collision that is still being retarded by lack of long-range radar facilities (AW April 25, p. 40). Last year, House Appropriations Committee voted solar appropriations for fiscal year 1958 from a requested \$50 million for 20 radars to \$15 million for 10 radars with instructions to make better use of military radar facilities. Military services have been cooperative in establishing ground-use of radar but the procedure is not always satisfactory for civil purposes.

## NEW LOCAL SERVICE VICKOUNT

# GREATER PROFIT POTENTIAL FOR SHORT-SECTOR HIGH-FREQUENCY ROUTES



### Low operating costs

On short-sector, high-frequency flights, the new Local Service Viscount will provide the lowest operating costs of any powerplant in this category. Design refinements

make possible exceptionally low break-even load factors on local service operations. Vickers engineers will gladly make a complete cost analysis of your routes.

### Proved popularity . . . big capacity

Since its introduction to American services in 1955, the Viscount has firmly established itself as the most popular of all modern airliners. Because of its broad smoothness, silence and speed, the prop-Viscount has become first

choice an average of 35% for 87 airlines worldwide. The new Local Service Viscount will comfortably accommodate from 54 to 63 passengers. In cabin configuration there is ample space for passenger luggage and mail

### Dependable, economical Rolls-Royce power

The Local Service Viscount is powered by four predominately proved Rolls-Royce Dart 504 in-props. These engines have demonstrated their outstanding ruggedness and reliability under operating conditions similar to those of local service operations. The Dart 504 engines are mounted

pass for mounting, ease of maintenance and hours between overhauls. (TCIA reports approach 1400 hours—with current test engine hour run to 2000 hours.) They give the Viscount exceptional take-off and climb performance and a cruising speed of 300 mph at 15,000 feet.

### FROM THE WORLD LEADER IN JET-

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The Local Service Viscount can be operated on routes of up to four 100-mile sectors—without refueling and with a minimum of ground handling. Passengers are made for fast maneuvering procedures resulting at terminal points (turning points) are also provided.

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recline water-tightness at intermediate stops.

The 36 engine can be kept running during intermediate stop-overs—that saving ample power for recurring the engine. If longer stop-overs are required, interval restarting is still possible because of increased battery capacity. Besides an undercarriage, 3.1 and 3 engines prevent vanishing of prop, port-side, quick on-and-off loading of passengers on the left side, freight on the right.

### Local Service Viscount means Jet Age growth for you and the communities you serve!

By cutting flying time almost in half—and by introducing Jet Age service comparable to the level offered by the "Airliner" class—the Viscount will open doors to important new business traffic that means accelerated growth. This growth will benefit not only local carriers, but the areas they serve—areas that deserve the experiences that come with the best and most modern airline service.

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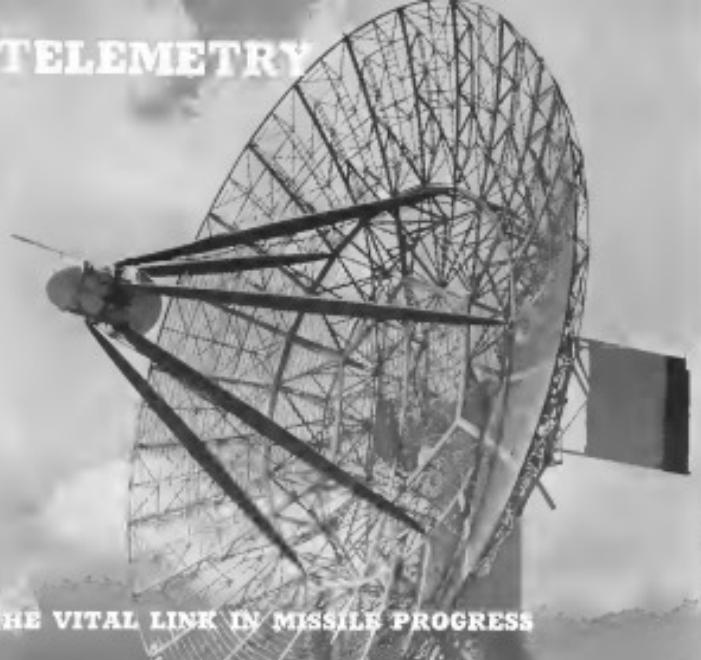
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Missiles are test-fried for many uses: purposes to obtain data that will help build better missiles. If the test does not yield the information it must be considered unsuccessful — regardless of how well the "bird" performed.

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# SPACE TECHNOLOGY



HVE subjects negotiate space cabin simulate at Wright Air Development Center for USAF by during a space flight experiment.

## USAF Simulates Space Crew Conditions

By Everett Clark

DODGE—Project Longshot—a series of simulated space missions flown by the men suited as a capsule—aircrafting astronauts that human factors will play an increasingly dominant role in the design of future USAF weapons.

Wright, a prime consideration in designing systems for atmospheric flight, will be even more important in space vehicles. Man won't only tolerate environment with less ease than he once got at those against the considerable resistance of the atmosphere.

Reliability, less critical in atmospheric entries because escape is possible will become far more critical in space flight.

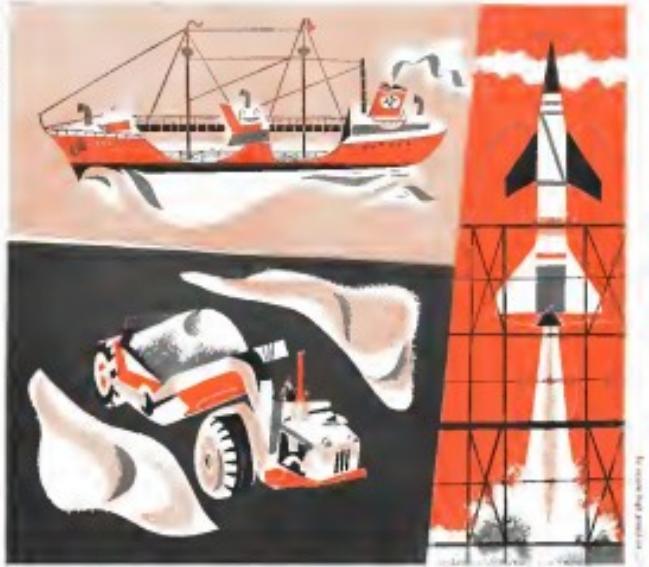
Rings, still measured in distances far right within the atmosphere and even for transnational varieties such as intercontinental ballistic missiles, is being measured by just now in a new dimension—the pleasure of space flight—that of man.

Human time is becoming so vital a part of the weapon systems design equa-



PHOTOGRAPH: oxygenated motion vibration in WADC space cabin simulation. Equipment is used to record volunteers' physiological, psychological and psychiatric behavior.





By Arnold Monk

## SWITCHES SET OFF BY SPEED!



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ted to the tasks that will be created in space travel. New sensors, new heat sources of various sorts, will much increase the spectrum of efficient operation of a complex machine.

To get the mission across, USAF researchers must attempt to simulate various space flight conditions as pure life. Weightlessness, acceleration, deceleration, exposure to cosmic rays, heat cold and radiation, buffeting and vibration at extremes, and other effects of orbital and aerospace space flight have been explored to some degree here and at other Air Research and Development Command Centers—but combining all these conditions still is impossible.

Paper Langley area is studying in great detail every of the more critical and least known factors—the photon, biological, psychological, physical and mechanical stresses and accelerations of life not exposed to Langley confinement.

All versions are built in a specially designed workshop of a crew capsule seat and ejection seat cushioning studies are the WB125A research number program.

### Growth of Studies

The current series of experiments is an outgrowth of confinement studies dating back to 1952, when one man sat in the grounded cockpit of an F-84 for 46 hrs.

First free-fall, free-fly mission was flown in May of 1957. Nicknamed "Long Gone," it was a dry run designed primarily to teach the researchers what the problems of confining the experimental would be. Next year was made for August with a successful mission.

The final mission, called Starflight, is to take place late March 13 to March 19, with another crew.

In 120 hrs, the man will make a free-fall short of the 147 hr duration to circumnavigate the earth on one parabolic orbit.

Next mission will be nonstop, weight-possible 15 days, simulating the 760 hr trip along a more profitable lunar communications orbit.

All experiments are set up as simple missions with specific tasks and specific work areas assigned to each man. Starflight 2 called for survival and landing at Wright-Patterson AB and space orientation around the earth, and reported the area to regions as they passed over Minnesota, stateside.

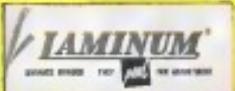
Critical period of the mission must have 100 to 104 hr, when the profile called for the module to change orbits for a photoreconnaissance run over Tokyo in a maneuver called Artificial Diving.

Only window of the five day flight are carried past at the beginning of the critical period when waste is in the elec-

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The test set caught fire. Members of the 3547th Maintenance team catalyzed the compartment enough to substitute a second test and performance of the mission went uninterrupted, although some data reduction reported later that they had swelled considerably.

Over the weekend protocol voluntary design of the electric test set type used on the B-52 has been modified to prevent a resonance.

Consolidated incorporates a number of unusual design features. It is 17 ft long by 16 ft wide. Its 100 cu ft are divided into a work area, top of fire arm storage, a food bar and a lounge area containing a pull-out bed.

Systems consist of integral water-cooled panels and redundant escape equipment for use in an emergency occurs in the atmosphere. Both environmental and capsule are designed so that no pressure, bridge or pressure seal is ever used, and capacities include 1,200 cu in of space for global survival gear.

Cylinders are designed for minimum volume, and maximum output. Polyethylene bags have been given a permeability that some claim can exceed 90% of that of the standard vinyl tubing. Polyethylene bags are unique in incorporating a self-sealing technique. Consolidated has selected one of three classes of high-accuracy gauge to refine function, even while in a spin. Radios and transducers cover the range at all altitudes.

On the first and second flights maximum performance came from the "stabilized" thermal-cook and roll checks, plus etc.—at their equivalent of winning and the relaxation when all others, thus, have dinner time coming. "Combustion" showed great less time. On the third mission, no preference pattern emerged.

Design of the compensation cylinder was a technological device in which the device consists of trapping an impervious surface between a fixed and moveable float in the reservoir set at 2 psi. The locking of a stop does to locate different valve schemes in the two main areas capsule "booster" from off-set and deep, 120 ft altitude. Some experts have suggested that more pressure is needed in the sleeping area.

In line with the philosophy that pressure measurements will relieve them and keep efficiency higher, each man is allotted considerable freedom in his choice of high-energy, low bulk materials and loads.

Flight became extremely important. After the first flight, even continuous track was taken down to 100 feet to ensure that considerable time both on and off site is spent at the dining area.

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... calibrates from 0.3 to 500 psi

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be," one of the plotters of the experiment said. "It's not so bad, but, unfortunately, we had hasn't yet found his best, final bar."

Roman and Jordan and the unusual source of thought that exercised gave no face because they know that, after all, people—themselves, others, themselves in fact—indeed.

On the occasion last August weight given for the live men ranged from 5 to 15 lb., and nose-ropes began to wonder what might happen on a mission of assault in caves.

On the next assault run, however, weight given were unquestionable, since reparation was called for.

"We found that the other four we had a food-obstinate leader," one physician explained. "He was a big egotist and he talked food and then food all the time. It was a power of suggestion. On the next flight all the personnel just starved."

Researchers accept that cues will have to be selected carefully, because of the effects of each on the others. Parachute training, as we know it, and development of techniques to minimize group conflicts may be necessary.

### Day-Night Cycles

Adjustment to day-night cycles proved to be a problem for these newcomers at first. Although this solved itself on the sheet flight that is still now doubtful, questions about much longer flights since man's physiology was intended to end regulated by the physical phenomena of the sun-earth relationship.

No man was seen at the same day-night cycles. The seventh commander, captain and flight engineer worked 16 hours and slept eight, but their shifts were staggered. The navigator and the force director worked a 12-on, 12-off routine.

There was always a referred sense among the drivers to serve as a sort of catalyst. Cassanova slept an average of more than 70% while off duty.

Although the subjects are pre-trained in the sense that they were USAF pilots with considerable military experience, there has been little specific training for the two-day mission.

There has been a certain extensive training, however, to prepare a baseline for evaluating physiological, physiognomical, psychometric and sociological changes. Evaluative testing also is done immediately following a mission.

Five days of briefing and three of practice, using an operating manual, preceded each mission, partly to ensure the psychological orientation that the crew are a team. Each man who spent 21 days in individual isolation.

During the mission, covariance was

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required to withstand severe accelerations, tape recorders and chronometers already check and their response to motion indicated on their movement pads.

ERC training saves and often measures of performance show excellent results. On the August edition pre flight Link former scores for all four men were above average. Post flight scores indicated 80% C performance for four men, but the fifth was scored below average. In last five months of flight, the captain-one of those who had been trained pre flight, has done with a full-stretched 95% on the glide path under simulated GCA simulation flying conditions.

Last two months of much hard of flight micrometeorological and galactic dust avoidance training were taken on each man by means of people lightweight harnesses which were plugged into dust stations. Also each man kept a diary, and to all researchers now he took painstaking note each day what his personal findings he might not reveal otherwise.

Data reduction and conclusion is a lengthy process. The Starlight 7 crew was not down until a good portion of the data was reduced and last Vagabond's flight had been studied.

No technical report on the Long shot flight has been released to the press and researchers are cautious about offical conclusions.

Although straightforward, a first sense of danger and other factors cannot be resolved on these flights, nonetheless here lies the strength of the Langley flight as yielding extremely valuable information on the effect of confinement and free on personal responses and group dynamics.

### Curtiss-Wright Gets AEC Reactor Permit

Washington—Atomic Energy Commission has announced its program to issue a license to Curtiss-Wright Corp. for operation of a plutonium research reactor at Oak Ridge. A 5-year interim permit was issued in May, 1957.

Reactors will be used for experimental programs involving shielding studies, nuclear component and system development, investigation of radiation damage, neutron physics and isotope production.

Furness, operating at a power level of 1,000 kw, "Furnet," is housed in company's Radiation Materials Laboratory on a \$1,000 acre tract near Germanna. License will be for 20 years.

In another action, the AEC said it also proposes to issue a permit to General Dynamics Corp., San Diego, Calif., for construction of a research reactor at Trinity Point Naval Station, San Diego.

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# MISSILE ENGINEERING



CLOSED CIRCUIT television screens (left) show various angles of launch pad. At center, technician monitors a bank of pre-launch checks. On right, engineer checks various sections of missile and associated systems.

LIGHTS on control panel (left) indicate status of a missile system. Technician seated (center) at console operates start. Man in foreground, S. V. Jenkins, Chief Test Conductor, shows what jacket is used.

## Missile Countdown is Complex Procedure

By Richard L. Sweeney

San Diego—Missile countdown, often the cause of prolonged confusion, often requiring days of work before launching, is now a well-defined sequence and checklist comprising 116 steps of the missile as possible prior to flight. Procedure has its roots in the very design concept of weapon systems such as the Atlas ICBM.

Protocol calls for checklist to proceed, before engine and control panels are placed in position—and before it is launched.

In the case of many missiles, written instructions to give desired test and the relevant data is an integral part of each configuration of the missile since this data must be present before any custom design is made final and before all nations are permitting its operation.

### Ensure Compatibility

Countdown also is considered in design of ground support equipment, to insure the complete ground equipment will work and that all parts will work. If all desired data will be obtained and that is how a develop test vehicle and weapon system the mission will be accomplished.

Consideration of checklist goes back almost to primitive design, since design parameters must be made for accomplishing the various checkouts of the missile and its myriad

parts before it is "locked"—i.e., before explosives are ignited paragraphs are placed in position—and before it is launched.

Do the job before the final firing frequency is determined X. X. Davis, Director, checkout of support equipment and facilities need to carry out operations from checked methods such things as spacecraft and supplies on hand, from film to liquid oxygen to liquid fuels.

Surveillance requirements are made for delivery to firing sites of weapons supplies which in that nature, are last minute items such as propellants, liquid oxygen and helium. Details concerning final delivery times as settled among test or support divisions will be made at a specific time and will not drift off the event.

Flight goes through as complete a checklist as possible, with attention of certain facility components such as

## Cape Canaveral Atlas Countdown—Step by Step

Cape Canaveral—The first stage of a typical Atlas developmental test flight checklist:

• At T minus 35 sec., the Atlas launch complex is closed off all personnel except occupants of the mobile launch blockhouse 750 ft from the pad. Pre-launch checks of the power system and other pre-launch checklist are conducted separately to segments and techniques working at consoles within the mobile launch complex and associated explosive areas.

• At T minus 25 sec., the mobile launcher begins calling off the passage of each minute. At 1 min. before launch all antenna sets are extended to the test conductor's radio circuit. All flight controllers go to work the checklist entries the final minute.

• At T minus 15 sec., test conductor receives "T minus 5 minutes and counting." Transistor switch's ac power comes from ground source to mobile source is completed, checked, sealed. Weight of mobile is accounted for instruments in block house. Helium supply pressure is checked. Level of liquid oxygen in mobile tank is checked and the flight pressurization sequence is started. Sequence involves 12 tanks, riding with checks of pressure in liquid oxygen and fuel tanks, and armoring "pressurization sequence" valves.

• At T minus 10 sec., the liquid nitrogen dump switch is opened and the liquid nitrogen drained from the mobile. Drainage process is monitored by blockhouse observers through periscope.

• At T minus 5 sec., blocker switch is sprung from capsule into blockhouse and turned off in safety measure. Blockhouse is sealed. This safety reported to launch pad safety officer. Safety personnel systems (mobile destruction) are checked in external power, sensing devices for system checked. Emergency dump valve opened to prevent quick discharge of liquid oxygen from capsule in event of an emergency.

• At T minus 1 sec., viewing of liquid oxygen tank started. Level is checked and brought to correct flight level. • At T minus 2 sec., capsule doors are opened or switched to internal power source from external source. Instrument gear "manned" to first step in starting breaching sequence to launch condition. Telecommunications ready when liquidated capsule is lowered to launch.

• At T minus 1 sec., 20 sec., test conductors make these checks. Panel operators repeat: "Composed on command (power-

stage)" "Eldorado in launch condition—Right" "Mobile launch external data—Right" "Pressurization complete—Right."

• At T minus .4 sec., fire conductor announces "T minus 10 seconds and counting." Range safety command device (range safety and mobile) and mobile detector explosive areas.

• At T minus .2 sec., test safety officer reports the range is ready for firing.

• At T minus .1 sec., test conductor makes these checks, panel operators respond: "Range safety armed light on—Right" "Range ready—Right," "Mobile safety armb—Right," "Propulsion completely light—Green" "Liquid oxygen tanking secured—Right."

• At T minus .05 sec., engine for extinguishing system checked, found ready. As the countdown proceeds, the conductor observes periodically at a dozen indicator lights on the periscope panel. One of these gives green at completion of each key function. Until all of the lights are glowing, an interlock circuit makes it impossible to start the rocket engines.

• At T minus .01 sec., test conductor announces "T minus .25 seconds and counting." Test conductor pushes remote engine start button. This is the last manual operation. From the point forward, all functions are automatic, but still can be stopped manually by test conductor if he sees indications of a failure of one.

• At T minus .005 sec., mobile launch safe start task is performed.

• At T minus .001 sec., interlocks that send information from mobile in flight are turned on.

• At T minus .005 sec., flame detector valve valve switch goes to full open. This increases water flow rate flame header to 35,000 gpm.

• At T minus .001 sec., main engines start. Test personnel watch carefully closely. Launch safe can be stopped if indications are detected.

• At T plus .05 sec., automatic launcher releases nozzles. A positive closure sequence opens the nozzle is beginning to tilt off the pad. All three are on the liftoff sequence that then the pad. The launcher slowly at first, the TV cameras are pointed to liftoff. The test conductor breaks the silence first. "She's going," he exclaims, "going... going... going!"

valves on the water system for exhaust, delivery cooling, diesel electrical generators and air compressor. This procedure emphasizes periodic maintenance and assistance that provide maintenance has been accomplished.

Simultaneously, such things as switches are positioned properly on the main checkout panels and possibly a few parts of the system which will not affect. Perhaps one or several instances would be required at this point.

Pre-countdown, with those who the countdown, must follow the "day before" checklist. It covers a specific list of things to do and a definite sequence. Although not a mandatory minute timer after it is scheduled to be completed within a certain block of time.

At pre-countdown, all scheduled activities are made and double checked at the site for accuracy of quantity and quality; even though they may not yet

be installed on the missile. A checklist is accompanied by each flight or power lines and gas transmission lines.

Now the time approaches when the people involved begin to settle down. The lighting is more, the trips to the cooler to get cigarette machine and restroom with extremes often begin to come to a halt. Furthermore, aircraft test crews will be gone and people will turn to the serious business at hand.

### Shutdown Monored

Final checklist are made to see that all supplies and materials are delivered, that all people are at their stations and that communications are in working order. In this effort, problems frequently are found which block start of the main shutdowns.

The finalized checklist, which will vary in time span, the shortest being about 4 hr, the longest according to mission requirements. Timing usually will start at Cape Canaveral, where 10 sec. to 12 sec. to 15 sec., depending on the type test to be run.

During the launch which can influence start of a countdown are:

• Requirements that particular van angle exist at missile launch, or at pre-

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TORK-SEL

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Now, at Tarback, a method of continuous O-ring sealing has been devised and has been tested with encouraging results. TORQ-SHEL, a memory sealant offering low static and dynamic friction, has a proven efficiency rating of approximately 85%, along with considerable reduction of backlash.

By eliminating the voltage loss inherent in rotary actuators, the manufacturers of TORQUE-SEEL can now offer industry a truly practical space and power-saving method of hydraulic actuation.

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#### **Soviets Claim Record Launch**

Rocket attained a record height of 204 m (673 km) after launching at night stage rocket shown in left side Feb 21. Rocket was launched from European section of USSR and contained gyroscopic variable orientation, solid-propellant descent and load. Engines total 3.34 kg rocket followed pre-planned flight. Research equipment was carried as usual. Rocket at night reached 152 m (500 km) and record equipment as left side.

*Never rest in work's "busy-ness."*

- Weather conditions over full range which affect photography, optical tracking.
  - Weather effects on communications, electroacoustic tracking equipment and instruments.

Final phases of countdown start after the missile is "loaded," when propellants and explosives fixed to destroy missile in case of malfunction, or in case of impact, are placed aboard and the missile becomes "hot" or armed.

At this point, access to the nozzle is removed so that the gunite are filled back, bulks and other nozzle equipment is taken away and all operations become remote. Emergency provision must be made for "self-jettison" adjustments since remote control is hazardous and unsafe.

Although first to sonography guided with guides still is place, blind margin is never placed about the muscle until the area is completely cleared. Safety is a top consideration at all points in muscle operations, and Corwin has never had a single accident in his work, back to the time of the first muscle biopsy (MV-374).

**MAGNESIUM?  
TITANIUM?  
STAINLESS?  
ALUMINUM?**



**KAMAN**  
CAN  
WORK IT

**HOUSINGS  
COMPONENTS  
SUB-  
ASSEMBLIES**

Korean software site implemented in all phases of aircraft techniques does the most job example to the complete air-force. They are uniquely qualified to make quantities modified to right specifications from the drawing to the finished product; complete with installations, shape of their apparatus has been with the airframe and the aircraft "tail" materials. Currently they are producing bearings for aircraft structures as a part of several missile and rocket programs.

Were you considering Komatsu Hydros for equipment bid until International Facilities informed us it had already been awarded.

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THE COLUMBUS DIVISION OF  
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## FLIGHT SIMULATOR

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convert these vector readings into a position corresponding to the defined space vector.

By thus reproducing the conditions of an actual high-speed maneuver over water or missile in flight, one can experience the sensations of any maneuver.

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environmental flight test, the goal is data.

Overall flight control is the responsibility of Range Operations (RO). He monitors the range, while the TC monitors the missile itself. These two merge their activity and efforts to ensure successful data gathering during the flight.

### Firing Team

The additional key positioned in a lock on the Pad Safety Officer in the blockhouse, who observes progress of the missile toward the launch, and the Range Safety Officer in the Control Center with the RO, who passes the distant bottom of missile warheads of concern.

During this part of the launch countdown, either the SRD or TC can adjust (stop and restart) the countdown in problem areas, working with each other. Final clearance to fly the bird is given by the SRD, and must be given before atmospheric sequence starts.

Automatic sequence period varies from 60 to 30 sec prior to zero time, permits the instrument operations automatically, but with manual override from blockhouse control center in case of malfunction.

Zero time is a highly volatile point. Its duration can include:

- Time ignition of rocket engine igniter
- Time propellant motor goes into main stage, or full propellant flow and thrust buildup to maximum
- Time of actual launch itself

Finally, zero time is a reference point rather than a signal for any predictable element in a missile launch to occur. Elements which come into play at launch are the radio frequency link-command, telemetry equipment, the distract engine. Developed by Canaric, the Ames center now serves for range tracking, but it has capabilities for becoming a guidance system.

An automatic sequencing of missile events starts at the time of initiation at 60 sec prior to zero and it also enters auto sequencing stage, but in certain elements are automatically activated, ranging from launch sensors to ad-preset value sets to downrange radar sites. This can be recorded in case of a malfunction or adjustment of the countdown which causes the automatic sequence to re-enter one of the normal outside control equipment.

### Vanguard Designers Detail Second Stage

Ames, Calif.—Second stage Vanguard rocket engine is fabricated from 1250 weldable aluminum alloy tubing, utilizes a spun case section and uses internal wrappings to absorb loads. Aeroflat Control Corp., fabricators and de-

signers of the second stage, are currently involved in finalizing the design.

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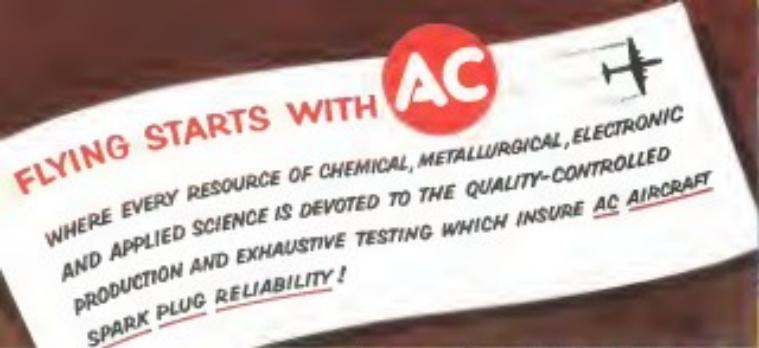
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FLYING STARTS WITH...  
**AIRCRAFT SPARK PLUGS**

FLIGHT NIGHT BECAUSE THEY'RE BUILT NIGHT

ON THE FOLLOWING PAGES SEE HOW AC SPARES  
NEITHER TIME NOR REPORT TO BUILD THE BEST...



**SPECTROGRAPH** Measures physical and optical properties of materials by means of light and electrical fields. The same basic principle is used in one of the stages of aircraft photomicrography to measure a



**ELECTRON MICROSCOPE** photographs atoms and other particles on various materials and how these extremely small together. Pictures are formed by electrons to magnify up to 100,000 times. This is another example of AC's microscopical equipment.



**RUBBER MOLDS** are necessary to insulate metals with pressure. They pass through moderate temperatures which also serve to harden them. These are used to insure uniformity in the insulation. The method is typical of AC's microengineering equipment.



**KODAK CONTOUR PROJECTOR** projects the profile of the samples. When it is necessary to examine a body with a great deal of detail



**KIN CONTROL PANEL** accurately measures height and temperature for all aircraft materials when being cut or getting precision. True diamond-like methods high temperature



**RHINESTONE GLAZE** is applied to the needles for AC's sewing surfaces prior to finalizing. Rhinestone prevent wear and abrasions which insures long life clothes.



**LIGHT BEAM TEST** Formulas are used. Test insures blades form the subject to obtain maximum efficiency. After this process, insulation is assembled into stage for engine dynamometer test.



**INSULATOR ASSEMBLY**—Insulators are held in position by heat and pressure. Insulators are held in the slots and form the insulating assembly used in conjunction with AC's



## FACILITIES

unparalleled anywhere for exclusive Aircraft Spark Plug production

**X-RAY PLATE INSPECTION** of every insulator assembly insures 100% pollution before it is ever shipped from AC. Only aircraft quality insulation is used in AC's aircraft. X-ray inspection insures quality of insulation and insulation is used to insure high results. All stages are used to inspect the insulator.



**DIAMOND SANDING** of rubber insulation is used to insure high efficiency. The heat and pressure combine intense heated welding of insulation and the open heating itself.



**INSULATOR ASSEMBLY INSPECTION** includes high voltage electrical current, Angle type, Micro type, visual and X-Ray for each spark plug of the entire production.



**MACHINING AND PLANING** is done by the machinists with many of them circuit and precision by AC. This process is only a few of the many facilities that have been developed for the production of AC's aircraft spark plugs.



DAY and NIGHT



here at



**MEN, MATERIALS,  
MACHINES combine  
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plugs that spark modern flight!**

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IT TAKES THE PERFECT COMBINATION of manpower, materials and machines to produce a superior product. That rare combination is inherent in every AC Aircraft Spark Plug . . . military—private plane.

At AC, experienced engineers, craftsmen, inspectors—devote themselves exclusively to the advancement of aviation through the manufacture of the finest spark plugs.

Fronts of alloyed steels, precious metals and durable ceramics are difficult to combine to assure reliable performance and a long life of trouble-free operation.

AC facilities for precise production, many of them engineered for particular applications, are used solely for the fabrication of reliable AC Aircraft Spark Plugs.

FLYING STARTS WITH



**AIRCRAFT SPARK PLUGS**

AC SPARK PLUG • THE ELECTRONICS DIVISION OF GENERAL MOTORS



**FINAL ASSEMBLY** where the smaller assemblies are joined in the plant. Testing units are connected in series of two or three to check insulation resistance between the electrodes and ground. After the shaft components are in place, they are painted, varnished and turned to form a hexagonal nut that meets their spec. at 1,000 psi. *not hot*



**FINAL INSPECTION** of the assembled aircraft spark plug assemblies is made inspection, insulation tests, high voltage leak test and final Knoop. After a final check for surface irregularities, the plug is tested by the hot wire technique.



**PACKAGING AND LABELING** a six foot line is needed for the AC Aircraft Spark Plug which undergoes a series of packaging operations to insure the quality of these fine AC Aircraft Spark Plugs that are being built and are produced.



AC's line of jet AC aircraft spark plugs includes the 100, 110, 120, 130, 140 and 150 models.

signs of the propulsion system, disclosed last week.

The tube yields natural characteristics for aircraft use; coated carbon while wire wrapping allows chamber pressures as high as 100 to 1,000 psi, although the Vangardian chamber pressure is less than 100 psi.

Temperature gradients, unanticipated during flight, can lead to fuel and insulation damage, freezing water and fuel under ice pressure load, with failure at pressurization load, and are expected at a moisture ratio of 1:8.

Although Ram temperature is in the range of 3,000°F., the high conductivity of aluminum alloy and low rate of the inhibited white freezing nitrite and oxidizer, which is the cooling fluid, combine to limit thrust chamber wall temperature to 450°F at maximum.

Thrust chamber is gasbubbled, yields 7,700 lb thrust at altitude, has a burning time of 138 sec. Dry weight of the propulsion system is 58 lb maximum. Minimum specific impulse is a variable, although the Vangardian chamber pressure is less than 100 psi.

Tubing for the chamber is of varying size due to variation in shape for the nozzle, wall thickness is below 0.016.

Tubes are shaped to the thrust chamber, nozzle throat and nozzle proper configuration so specially made forming dies, then welded together for the nozzle.

Nozzle expansion ratio is 23:1, and exhaust velocity for the engine at altitude is from 9,340 to 9,800 fpm.

# Complete Aircraft Testing AND OVERHAUL Facilities



- ✓ QUALIFICATION TESTS
- ✓ EVALUATION TESTS
- ✓ PERFORMANCE TESTS
- ✓ ENVIRONMENTAL TESTS
- ✓ AND OVERHAUL FACILITIES

## Optical Tooling Devices Check Missile for Correct Alignment

In launching of large missiles, precise alignment must be maintained to insure deviation and corrective fuel consumption which may cause an expensive price of hardware in the target.

Problems of alignment is basically the same for all large missiles, whether they carry a warhead or a satellite, and it makes little difference whether they are aligned to true vertical or to some specific angle less than 90 deg.

What actually creates a problem is the high degree of precision required—precision beyond that attainable with

conventional methods of surveying tools. To achieve desired accuracy, missile teams use optical alignment devices, some of which have been developed specifically for the work while others were adopted from earth already in use on the production line.

For the Vangard, the error in alignment of the vehicle over the calculated center line running through the vehicle must not exceed two inches if deviations from true vertical. To position the vehicle within these limits optical tooling devices supplied by Keuffel

& Esser Co. are being used.

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**AIRCRAFT EQUIPMENT TESTING COMPANY, Inc.**

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## Grafting metal skin on glass eyes



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Paul Street, Rochester 2, New York.

BAUSCH & LOMB



Fig. 1. Target on board follows

The target, equipped with signal equipment capable of generating 0.001 m. at 40 m. in the X and Y (crisscross) by conventional surviving parameters which averages at a right angle. Since each retains the tail of eight of the target is able to describe an elliptical path which is vertical (each target is carefully loaded on its own specific platform to make sure that the signal source is truly vertical). The orientation of these ellipses form a hyperbolic curved line at the center of the screen.

The targets (lens A and B on the ground) are made from each stratospheric aircraft crosshair target placed on the outside of the vehicle top and bottom with reference to the calculated center line. The placement of the target takes place while the Vanguard is still in the Martin Co. plant in Baltimore, Md.

When the upper target reaches its position in the instrument, refraction to the lower target causes various signal tolerances, i.e., when the displacement of each target is the same from the optically excited plane, the object is within within one plane. When the upper target reaches its position, it again similarly confirms the object is vertical in a second plane. And since the two planes are at right angles, the rocket is then truly vertical. (Adjustments in either plane are made as needed with locking pads which are under the launching pad.)

### Vanguard Alignment

In the case of Vanguard, there are other problems presented by alignment of the third stage. When the first stage is attached at the launch pad, its thrust vector must be aligned to the planet's axis within six minutes of zero. But the third stage is too short to use the same technique as the first, i.e., external motors would be spent too close to define the exactitude accurately.

To solve this problem, Keeler & Esen developed an optical alignment called an auto-aligning phase shifter, which is essentially a fixed focus telescope held vertically in a special mount. Techniques for using it are as follows:

Front surface mirror is affixed to a flat pad mounted on top of the third stage engine so that the mirror surface is square to the thrust axis. The amount of tilt of the mirror corresponds to the deviation of the third stage thrust from the planet's axis.

To align the front surface and direction of the tilt, the adjustment is made in the gravity to a position about the third stage. This involves of the instrument in alignment parallel to the planet's surface ground base with the end of one of the later stages and two offset

## Intercept research at Westinghouse



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For today's defense by fleet aircraft and tomorrow's by space ship or missile carrier, positive interception systems are being designed and built at Westinghouse Air Arm.

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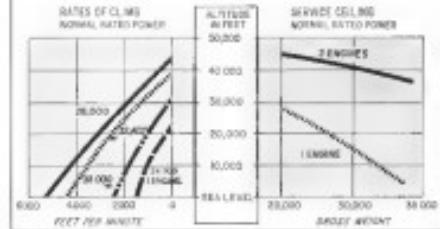


LOCKHEED CL-323 JetStar ground visibility runs 40 ft. ahead of nose. Tread is 10 ft. 9 in.; wheel base is 20 ft. 9 in.

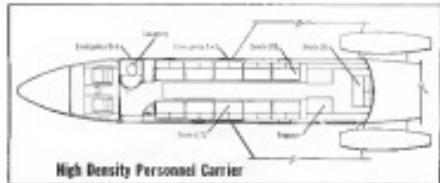
### Aviation Week Pilot Report

## JetStar Appears to Meet USAF Needs

By Robert I. Stanfield



PERFORMANCE chart based on T377 turboprop. Configuration below carries 22 passengers.



**Merits.** On-Performance and characteristics at varied speed requirements indicate that Lockheed's first all-jet fighter CL-323 is well suited to USAF's urgent need of a fast jet replacement for its current crop of obsolescent World War II piston-powered fighters.

JetStar currently powered by two Bristol Orpheus 1/5 turboprops (AW, Sept. 30, 1957, p. 108), demonstrated its adaptability for training, navigation, bombardment, flying targets, doing high-speed reconnaissance and operating as an electronic intelligence receiver. In addition to its capability at a high B-57 10-passenger VTPR jet transport it can load some 4,000 lb. of cargo.

Flight evaluation by Aviation Week pointed up these key features of the aircraft:

- Aerodynamic and climb. Airplane or aircraft from idle to maximum thrust lies at 10,000 rpm—in about five sec. Practically no time was off the ground or less than 1,000 ft. at about 120 kt. Acceleration to initial climb speed of 150 kt. was rapid. Flying over the end of the 10,000 ft. runway, our rate of climb speed was 250 ft. We were held to initial rate of climb of 4,000 ft./min. because of low cloud deck. Max. climb at sea level is 6,000 fpm.

- Fuel and range. Fuel is carried in wing integral tanks, plus sweep tank of about 150 gal. is located mid of wing root. Capacity of each wing, including sweep, is 700 gal. for normal total of 1,640 gal. or 11,300 lb. Fuel is kerosene-type (R-4).



STANDARD passenger cabin seats 20 with 30-in. spacing (left). Flight controls are dual (right); cockpit controls are centralized.

Over 1000 ft. at all speeds. Power required are on a par with those similar aircraft representing engine aircraft. We flew downwind 117 miles at 150 M. IAS, at 315, economy fuel at 115. Landing distance demonstrated 3,000 ft. Wind was equivalent at 10 kt.

- Jet power. Engine pods are mounted high and aft on fuselage. Current test flights are prototype. Centaur Wright axial flow type 3155 rated at 4,500 lb. sea level thrust at takeoff, 4,300 lb. thrust for maximum continuous speed. Dry weight of engine is 900 lb. Thrust/weight ratio is 4.9 to 1. Compression ratio is 4.4 to 1. Air flow is 41.6 lb. per sec. Prototype JetStar has been flown single-engine from 115 kt. on ground, accelerated at 1,000 fpm to 700 ft. in 10 sec., and continued to 15,000 ft. at 22,000 ft. at 600 rpm.

- Speed and altitude. Over weather capabilities of CL-323 are evident. We reached 10,000 ft. in about 10 min., including free speed climbing for hole in low-level clouds layer. At normal power we took off at about 513 rpm. Airplane can fly at altitude of 45,000 ft. at speeds in excess of 400 mph. Air conditioned and pressurized. JetStar was comfortable and quiet. Cabin pressure altitude of 5,000 ft. is maintained at 45,000 ft. altitude. Cabin pressure differential is 0.7 psi.



Ridge may be increased up to 300 gal. upper tank or 450 gal. glove tank on each wing. Normal range of the JetStar is 1,500 miles at sea level. With two passengers and fuel load increased to 2,200 more on, range is about 70 lb. 14 load limit plus one extra passenger at sea level in base of Md. 501 A.

### JetStar CL-329 Dimensions

Wing area (sq. ft.)	1,523
Aspect ratio	5.5
Span	83.81
Length	32.00
Sweep, C.G.	30 deg.
Span	35.12
Length	18.19
Height	20.97
Horizontal tail area (sq. ft.)	.149
Horizontal tail span	24.9"
Lift-to-drag	2.95
Vortex lift area (sq. ft.)	1.60
Total wing area (sq. ft.)	3,651
Total wing area (sq. ft.)	3,696
Fuselage diameter outside	6.5"
Head room, male to ejection	3.4"
Cockpit length	6.5"
Cockpit height	5.5"
Seat spacing	40"
Cabin dimensions	2.18
Min. door width	.32
Min. aisle capacity (passenger)	12.7
Min. cargo (ft.)	4,800
Normal fuel, without wing (gal.)	1,640
Intermediate fuel (gal.)	2,200
Minimum fuel (gal.)	2,800
100 gal. reserve tank per wing	640 gal.
Fuel in kerosene-type (R-4)	



Front Edge: indicates when radar is only time exceeds preselected threshold. Other edges can be measured with frequency tolerance and relative power meter.

## New portable radar tester makes fast "go, no-go" check

Tests all radars aboard aircraft, requires no training to operate

Here's the fastest means yet developed for testing aircraft radar on the flightline or in the field. It's the new Sperry Marconi® Radar Performance Tester and anyone can use it—no special training is required.

Weighing only 24 pounds (38 for C-band), this tester is self-powered (transistor and battery) and is easily carried about. It prevents costly delays by providing a quick, non-destructive check of all aircraft

ready in only minutes

This is the only performance-test that checks the alignment between transmitter and receiver positively and non-destructively by flipping a single switch. Infrared diagnostic plug-in echo box carries permanent checking either C or X-band modes. Transistorized circuits with built-in testing features contribute to light weight and reliable performance.

If you'd like to know more about the

New Sperry Master Radar Perform-  
ance Test, with our Masterwork  
Electronics Division

Handbook of Quality Management

### **CHURCH**

**DISMANTLING OF SHERIFF RAND CORPORATION**



**SHOOTING:** Initial posture is about to touch down. Flaps are fully open slotted type. Drag chutes can be used if necessary.

prefer the four jet configuration with 55 turbulents.

Lockheed also holds active design positions for about 98 commercial firm pending USAF order.

Liftoff specs show top speed of the four-engine configurations to be 613 mph for normal mission, 595 mph for extended range. Optimum cruise speed with four engines would be 510 mph for aircraft mission, 484 mph for extended range. Stall speed, best cruise altitude, at max landing weight of 26,000 lb., is 156 mph.

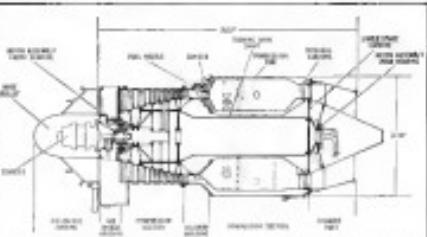
#### Engine Availability

Production T-37 original 100 hr type certified, will be available in April 1959. Production is reduced because it has cost to be 500 hr by mid-1959. Two JetStar prototypes have been flown about 250 hr with 1957 production. AVIATION WEEK was told that prob. engine burns a different more severe fuel than was indicated. 4,000 hr flight test on one JetStar flight was over delayed because of engine trouble.

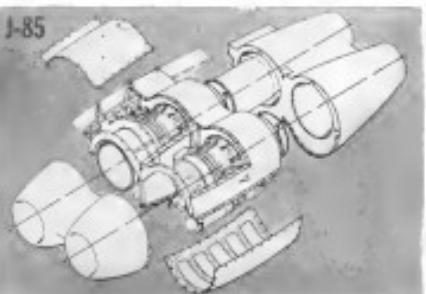
Airplane *no* flew two prototype, N328K, which previously had been flown about 25 hr. *No* number one prototype, N329J, with total time of about 200 hr. had been flown about 30 hr. by USAF during Phase II testing at Edwards AFB, Calif.

Long nose implants—58 ft 10 in long, with wing span of 53 ft 8 in—was low and drag in ground. Height over tail is 28 ft. 6 in. Wheel track is 10 ft. 9 in., wheel base is 24 ft so nose burner antenna and electronic equipment. Because of nose cone lift-off cannot mount AN/APM-59 radio. Lockheed will propose use of smaller commercial equipment.

Hydrogen and the coordination 18.3



**GET-WEIGHT**  $\oplus\ominus$  Indigo engine (below) has a 49-to-1 weight ratio. Drawing below shows how two General Electric GE's would be mounted on a four-engine fighter.



ANSWER KEY Page 10



## Need Seamless Steel Tubing Immediately?

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ture, plus luggage space are limited just forward of doorway, are accessible through steel hatch door. Cabin length of 28 ft. affords flexibility of interior arrangement.

Walk-around inspection shows dimensions of engine. Wings are swept back 34 deg from fuselage. Engines, aft of ring, can be easily serviced and maintained. Access to single speed reversible and low speed compressors is provided by split housing. Hatch half is quickly removable for inspection of engine in lower portion of compressor.

With the exception of enough cabin space forward of pilot's seat, there does not exist any pilot's compartment and forward of cabin, on left side. Thus storage, forward and aft to open. Control handle is made and attached and does not extend to floor between type locks. Control handle fits flush on floor when locked. To lock and unlock, handles are rotated 90 deg.

Cabin is lesson type and roomy. With 6 ft. 2 in. head clearance no difficulty has to do. Avionics are fixed and 10-passenger circuit configuration. Cabin baggage compartment, 27 in. x 16 in., fits one. Max baggage space is provided aft of cabin in spray center via left openable hatch door. Emergency exit is located adjacent to right-hand member. The passenger seat which operates over leading edge of right wing.

To the rear is a double door 28 in. x 36 in. galley of 20 in. x 36 in., and lavatory, 42 in. x 29 in.

### Comfortable Cockpit

Cockpit is compact and comfortable. One man alone can fit aircraft without any strain. Seats fully adjust to height, fore and aft movement and tilt of backrest. Flight controls are decked out with trim wheel and rudder pedals. Rudder adjustments for letters are on control columns. Flight instruments are mounted on both pilot's and copilot's deck. Navigation instruments are contained.

Engines, main landing gear, nose gear, main gear, fuel emergency transfer controls, VHF, ADF, air-

speed and control position indicator placed.

Overhead panel, located above, in cabin cabin heat and pressure instruments and switches, starting switch, cabin lighting, cockpit light and radio controls. Fuel with pilot are mounted adjacent to seats.

Each engine contains auxiliary starters with an under seat duct bullet. An auxiliary at pressure of 200 psi provides starting power when either in two seat engine through rotation of planetary gear, clutch and engaging exclusively.

Starting procedures for Jeffair are

extremely simple. Nozzle first, hydraulic pump on. Starter provides pressure for ignition of fuel boost pump. Start selector to left engine ignition switch turned on. Start an alternate fireline to idle. Ignition switch on. Once pressurized, a follow-on is followed for right engine.

Left engine fired up quickly and open is advanced to 5,000 rpm to supply more bleed air for operation of left air turbine motor. With left ATGM, no generator runs on, so air turbine motor is continued. Once an alternate source is continued in bypass configuration, control in speed blade for operation of two hydraulic pumps and two d.c. gen-

# Buckeye's

COMPLETE LINE OF REFUELING  
EQUIPMENT FOR ...

### OVERWING REFUELING

No. 3040 high capacity nozzle features easy mounting, soft closure, automatic ground connection and self-sealing. Also No. 3041 Max-Del oil nozzle for delivering 1000 lbs. oil. Features seal-off, non-drip valve in end of tube.



### UNDERWING REFUELING

No. 4000 valve is easily installed for ground refueling stations. Makes possible, high-speed instantaneous flow rate, designed to deliver 600 gpm, at pressure drop of 8 PSI through valve and adapter device. Various models available.



### HYDRAULIC SYSTEMS

No. 12200 Emergency Shut-off valve can be manually controlled. Adapter project valve and emergency shut-off valve work independently of each other.

Also No. 4000 series standard hydraulics isolators. No. 4000 series hydraulics coupling valves.



SUPER hole is close to ground, contact for use during landing, takeoff, or landing.

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For temperatures of -30°F and below

## Sola-Flex<sup>®</sup> joints provide safe, easy handling of liquid missile fuels

**MISSILE DIVISIONS**, and in Convair's Atlas ICBM, require the very best handling know-how—and equipment. These rugged Sola-Flex expansion joints are in use at Convair's test facility in San Diego, California. Made from 301 stainless, the 8 in. double-end swivel-base unit handles over 5 cu. ft. of axial movement in a LOX test line.

Solar manufactures the most comprehensive line of bellows and expansion joints in the world. They are made from a wide variety of stainless and high alloys for important nuclear, missile and industrial applications—in sizes ranging from 1/2 in.

to 25 ft in diameter. They are built for service from -300°F to 1200°F. And they can "hand-to-hand" pressures up to 3500 psi for special applications.

A new pamphlet describes Solar's complete line of expansion joints. Write for it to Dept. F-10, Solar Aircraft Company, San Diego 15, California.



## No other missile test lab can do all the things we can do

Take our 100-foot test tower. With it we can simulate the jettisons and separation loadings that occur during the actual launching and flight of a missile.

This is just one of the many specialized facilities and tools that we have built up in the last ten years. During this decade—because of our complete responsibility for the development of a major weapon system—we have built up a wealth of experience in many related fields.

The upshot of this is that we can handle any project from basic basic research to static and dynamic testing of complete assemblies.

For example, we can simulate aerodynamic loads and loading of the same sort...on a complete wing or a large section of fuselage. We've old hands at applying heat gradients from 100° to 1500°, temperature differentials up to 100°, and pressure specific air temperatures.

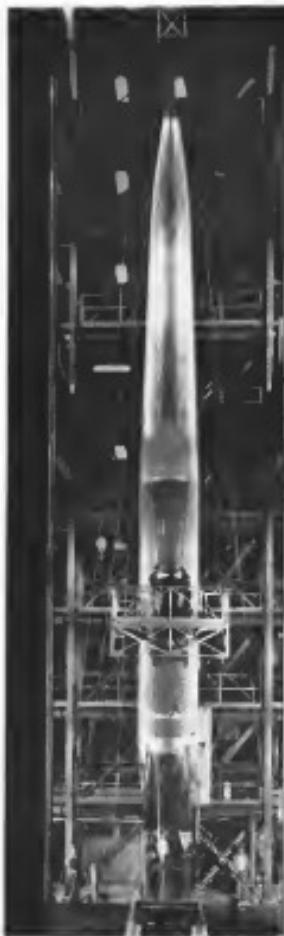
We're completely qualified to work with any kind of metals—aluminums, stainless, and precipitation, titanium, hydrides and plasma-annealed compositions and systems; structures; tribologic; environmental testing (including re-entry); and instrumentation.

Now we'd like to solve your problems. The tougher the better.

Please write to E. R. Schenck, Missile Division Test Lab Manager, North American Aviation, 12214 Lakewood Blvd., Downey, Calif.

## MISSILE DEVELOPMENT DIVISION

North American Aviation, Inc.





The almost instantaneous return to normal of the new low-alumina Cat power unit under conditions of full-load application, and load rejection (137.4 volt), is shown in the above graph.

**Low-alumina Cat power unit with close voltage regulation is now being used in conversion with ground support for jet starting and bring-up. The 400-cycle phase is specifically adapted to stability.**

## Caterpillar power fires SNARK...first U. S. intercontinental missile

The U. S. Air Force SNARK SM-62, the first U. S. intercontinental guided missile, is fired with power from an electric set developed by Caterpillar and now being supplied to the military.

The final designation of this specialized power unit is Caterpillar 60 KW 400-cycle 120-208-voltage low-alumina portable ground support unit with precision voltage regulation.

The secret of this unit is its almost instantaneous recovery to both applied and rejected loads.

Other advantages found in all Caterpillar Regas units include: trouble-free operation over a wide range of loads; dependability and long life; economy of operations; maintenance and operation by unskilled personnel; world-wide parts and service, and the ability to operate on any fuel from JP-4 through No. 2 furnace oil.

Conservative engineering and quality of manufacture

have made Caterpillar the diesel leader for more than 25 years. For detailed information on the Cat 60 KW 400-cycle portable power unit with close voltage regulation, send us the coupon below.

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ensured. Right engine was held to idle. Self-contained starting system also safely used for APUs, with savings of weight.

Testing was smooth and all-rotated windmill speed used for good credibility. We moved it at a fast clip with the high rpm on left engine. An turbine motor for hydraulics and electrical systems will be installed on production models. Systems will be run off different type jets on each engine.

### Here's What Started

Nose wheel deflection for steering, via wheel on pilot's side, at 50 deg in each direction. Brakes can be used where necessary.

There were 12 of us aboard, including Leo Sullivan, chief engineer and test pilot of Lockheed's Models 10 vision, and Bob Schenck, special projects test pilot who has been with the Jetstar since its inception.

With full complement, plus some 6,000 lb of fuel, airplane ground out at 24,213 ft. Center of gravity was 3.95 MAC.

With full payload, nose down 50 deg at 10 ft. Sea level pressure was 29.77 in. Outside air temperature was 65°F.

We took off to the east, no flap, with throttles to 10,000 rpm. Acceleration from idle to full power took about 5 sec. Airplane moved fast down runway and at about 50 ft. started becoming effective. Nose was nose down at 95 ft. and Jetstar was airborne at 128 ft.—before we hit the third marker on the 10,000 ft. runway.

With 45% flaps, CL-179 can get off at 10 ft. slower speed; we had many. Full flap (CL=100%)—overleads flap 50 deg.

### Cloud Speed

At altitude cleared weather, initially at 162 ft. and 10,000 rpm. Maximum specified speed with gas turbine is 200 ft. At 3,000 ft. we found our best climb speed of 235 ft. IAS, reducing rpm to 9,500. Speed and rpm were held constant up to 5,000 ft. (Max continuous power is 9,000 rpm or 850°C exhaust gas temperature).

Visibility was excellent during climb. However, we had to restrict rate of ascent—limiting to 4,000 ft—a decrease of climb deck at 5,500 ft. About 15 min. out we found a hole and went in.

At 9,000 ft. rate of climb was 4,500 ft/min. Exhaust gas temperature was 610°C, and flow 1,220 lb per hr. Rate of rotation of engine was evaluated during climb. Normal communication possible between pilots and passengers. Lockheed plans further aerodynamic fix for production model.

Jetstar turned out really during sunset, for head-on flight. Elevator and aileron control was augmented by the



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plies, boosters. Pilot supplies only one-eighth of total force required for altitude control, one-third of force required for elevon control. Rudder pedal forces are reduced by means of the servo assistance of trim tab.

Airplane climbed through 20,000 ft at 3,000 fpm, from 30 to 35,000 at 1,200 fpm.

At altitude, pulling 50% power, JetStar indicated 270 hr. At altitude was air temperature gamma. Estimated outside air temperature is 30° F. At 30° F., flight on 7.76 hr to 30,000 ft or 315 min.

Control at 35,000 ft was good. Wind had no trouble (outside of 60° angle). Holding altitude during climb at various degrees of bank and suspended jetstar in trimmed attitude by switch on center pedestal, which automatically actuates tabs to left ailerons.

Rudder oversteer starts flat, goes off for longitudinal trim. Vertical fin is braced at lower left corner and is braced by a c-c rod driven double scissor jack. Total weight is 9 deg. of stability angle. Two vehicles located on each side of pedestal, for pilot and copilot control arms.

In view of the above, it is determined that two seats are required on each control wheel so that either pilot may take all power connections to trim switches.

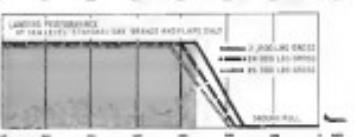
During flight, airplane remained

quite comfortable. Cabin pressure at cruise held to 5,000 ft. Passenger area system will automatically pressurize system when altitude reaches 10,000 ft.

Should depressurization occur, cabin compartment door adjacent to each passenger seat will open, revealing emergency oxygen. System also can be controlled by pilot.

If cabin altitude exceeds 10,000 ft—which will happen at 45,000 ft—it

**Fold Length Requirements**



increases from below approximately 5,000 rpm—warning light will alert pilot.

Airplane is presently limited to 425 kt. TAS for extremes of speed, load, location under and air on landing, just forward of empennage. Heels will serve as a primary landing gear, nose as a secondary, nose, no prototype, no landing gear, no rudder, no hydraulic and no air conditioning system.

Speed break controls small landing

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## *It tracks down an enemy at 300 miles*

Described as the most potent of all ground-to-air defense missiles, the Bomarc priceless interceptor, designed by Boeing, stands poised for the destruction of any "enemy" bomber within a 300-400 mile range. Its booster rocket has the power to hurl it more than 60,000 feet straight

up, then, powered by two ramjet engines, it battles by electronic instinct to its target at up to 5 times the speed of sound. For this guardian of our homes and way of life, RCA has been privileged to supply important advance components of the guidance system.

down within its own structure to a disc buffer. Total travel is about 60 days. We designed both at altitude and low altitude deflection of aircraft, with only right pitching academics.

With basic extended, and flexibly in idle, descent can be made from 40,000 ft to 10,000 ft in about four minutes—at rate of 6,100 fpm.

We dropped down to 21,000 ft at rate of 6,000 fpm. At that altitude we cut back power and stalled jetison in clear configuration. Tests were made with nose cone half centered. Right wing deflected lower due to excess of fuel over left, necessitating silicon control device entry.

Still, warning—continuous intruder—sign lit through headlights and lead speaker sounded about 120 db. TAS still was provided by steady buffer bit fire break. Airplane broke at 300 ft. There was no sharp drop. With normal recovery procedure, altitude loss was about 200 ft. Airplane can be "walked" out of itself.

Automatic wing leading edge slats over entire span in wing tips, aid in providing reduced stall speed and improved characteristics of slow speeds.

We think now of a second wave with losses of 10%. When maximum point force was used, excessive strength was required to fit another. Still results were about the same.

### Single Engine

With turbine mounted on rear fuselage, single-engine performance presents no control problem. Rapid turn is not necessary. We set the right engine and needed but one degree of roll side load to maintain directional control, slight clockwise trim in expected turns.

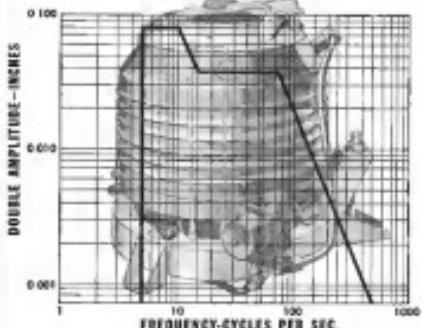
Turns from zero and with dead center flight characteristics were normal. Specifications state that best single engine speed, gear up, is 165 ft per second, 145 ft.

All turns are simple and made with rhythmic closed, emergency fuel shutoff valve open, controlled on. Rate of 1,100 ft/sec should be maintained at a speed of about 165 ft. Turning tendency to air start, therefore was advanced light-off, occurring before throttle reached 100%. After rpm stabilized, trim was normal again.

No engine fire extinguisher system is installed in JetStar. Guarded switch on radio instrument panel, which operates when located in wing fillet, gives emergency fuel shutoff in event of an gear fire.

Toolset for extinguishing water, consisting of two 6.5 lb. CF300 bottles @ 400 psi are provided for quick basic maintenance. Switch is on cockpit instrument panel.

Automatic refueling is provided by bleed air. JetStar places both an wing



## NEW "RUGGEDIZED" BENDIX OXYGEN CONVERTERS

meet MIL-E-5272, Procedure I, ruggedized requirements

The superior design and shock-resistant features of Bendix' new liquid oxygen converter was given ready remedy to severe vibration test conducted at Pacific-Central Division, premier producer of airborne liquid oxygen systems. These advanced 16-liter units withstand Procedure I maneuver and cycling vibration test at room temperature as specified in MIL-E-5272, Section 4.3.1.

Moreover, these compact units measure only less than 7.5 per cent larger than the standard MIL-E-5272 Military Specification and measure less than 10% larger than 1-liter predecessors.

Other design features include: An oxygen circuit that permits low pressure operation with maximum use of available gas, with little or no waste.

Two sets of extinguishing water, consisting of two 6.5 lb. CF300 bottles @ 400 psi are provided for quick basic maintenance. Switch is on cockpit instrument panel.

Automatic refueling is provided by bleed air. JetStar places both an wing

water, a gas/electric gauge probe that can only consistently meet the broad level needs the converter regardless of pressure, but by being removable greatly facilitates replacement and converter decommissioning.

Bendix Liquid Oxygen Converters are available in a variety of configurations—including an inverted mounting design. They are easily adaptable to virtually any hypobaric-performance aircraft. No matter what your oxygen breathing requirements may be—either aerospace or submarine—Bendix is prepared to serve you. PIONEER-CENTRAL DIVISION, BENDIX AVIATION CORPORATION, DARTMOUTH, MASS.

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- -54°C to +125°C standard temperature range
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- Assembled under closely controlled environmental conditions



400 CPS SERVO MOTOR-TACHOMETER DIMENSIONS

Size Type	Size	Overall Length	MOTOR		TACHOMETER		GEAR TRAIN		GEAR TRAIN	
			Shaft dia.	Shaft length	Shaft dia.	Shaft length	Shaft dia.	Shaft length	Shaft dia.	Shaft length
MOTOR 100-10	8	1,000	0.35	0.75	0.35	0.75	0.35	0.75	0.35	0.75
MOTOR 100-10	10	1,110	0.45	0.75	0.45	0.75	0.45	0.75	0.45	0.75
MOTOR 100-12	12	1,210	0.55	1.00	0.55	1.00	0.55	1.00	0.55	1.00
MOTOR 100-15	15	1,310	0.65	1.00	0.65	1.00	0.65	1.00	0.65	1.00
MOTOR 100-18	18	1,410	0.85	1.00	0.85	1.00	0.85	1.00	0.85	1.00
MOTOR 100-24	24	1,510	1.25	1.00	1.25	1.00	1.25	1.00	1.25	1.00
MOTOR 100-30	30	1,610	1.65	1.00	1.65	1.00	1.65	1.00	1.65	1.00
MOTOR 100-35	35	1,710	2.05	1.00	2.05	1.00	2.05	1.00	2.05	1.00
MOTOR 100-40	40	1,810	2.45	1.00	2.45	1.00	2.45	1.00	2.45	1.00
MOTOR 100-45	45	1,910	2.85	1.00	2.85	1.00	2.85	1.00	2.85	1.00
MOTOR 100-50	50	2,010	3.25	1.00	3.25	1.00	3.25	1.00	3.25	1.00
MOTOR 100-60	60	2,110	3.65	1.00	3.65	1.00	3.65	1.00	3.65	1.00
MOTOR 100-70	70	2,210	4.05	1.00	4.05	1.00	4.05	1.00	4.05	1.00
MOTOR 100-80	80	2,310	4.45	1.00	4.45	1.00	4.45	1.00	4.45	1.00
MOTOR 100-90	90	2,410	4.85	1.00	4.85	1.00	4.85	1.00	4.85	1.00
MOTOR 100-100	100	2,510	5.25	1.00	5.25	1.00	5.25	1.00	5.25	1.00
MOTOR 100-120	120	2,710	6.05	1.00	6.05	1.00	6.05	1.00	6.05	1.00
MOTOR 100-150	150	3,010	7.45	1.00	7.45	1.00	7.45	1.00	7.45	1.00
MOTOR 100-180	180	3,310	8.85	1.00	8.85	1.00	8.85	1.00	8.85	1.00
MOTOR 100-240	240	3,910	12.45	1.00	12.45	1.00	12.45	1.00	12.45	1.00
MOTOR 100-300	300	4,510	16.05	1.00	16.05	1.00	16.05	1.00	16.05	1.00
MOTOR 100-350	350	4,910	18.45	1.00	18.45	1.00	18.45	1.00	18.45	1.00
MOTOR 100-400	400	5,310	21.85	1.00	21.85	1.00	21.85	1.00	21.85	1.00
MOTOR 100-450	450	5,710	24.25	1.00	24.25	1.00	24.25	1.00	24.25	1.00
MOTOR 100-500	500	6,110	26.65	1.00	26.65	1.00	26.65	1.00	26.65	1.00
MOTOR 100-600	600	6,510	30.05	1.00	30.05	1.00	30.05	1.00	30.05	1.00
MOTOR 100-700	700	6,910	33.45	1.00	33.45	1.00	33.45	1.00	33.45	1.00
MOTOR 100-800	800	7,310	36.85	1.00	36.85	1.00	36.85	1.00	36.85	1.00
MOTOR 100-900	900	7,710	40.25	1.00	40.25	1.00	40.25	1.00	40.25	1.00
MOTOR 100-1000	1000	8,110	43.65	1.00	43.65	1.00	43.65	1.00	43.65	1.00
MOTOR 100-1200	1200	8,510	47.05	1.00	47.05	1.00	47.05	1.00	47.05	1.00
MOTOR 100-1500	1500	9,110	53.45	1.00	53.45	1.00	53.45	1.00	53.45	1.00
MOTOR 100-1800	1800	9,510	56.85	1.00	56.85	1.00	56.85	1.00	56.85	1.00
MOTOR 100-2400	2400	10,110	63.25	1.00	63.25	1.00	63.25	1.00	63.25	1.00
MOTOR 100-3000	3000	10,510	66.65	1.00	66.65	1.00	66.65	1.00	66.65	1.00
MOTOR 100-3500	3500	10,910	70.05	1.00	70.05	1.00	70.05	1.00	70.05	1.00
MOTOR 100-4000	4000	11,310	73.45	1.00	73.45	1.00	73.45	1.00	73.45	1.00
MOTOR 100-4500	4500	11,710	76.85	1.00	76.85	1.00	76.85	1.00	76.85	1.00
MOTOR 100-5000	5000	12,110	80.25	1.00	80.25	1.00	80.25	1.00	80.25	1.00
MOTOR 100-6000	6000	12,510	83.65	1.00	83.65	1.00	83.65	1.00	83.65	1.00
MOTOR 100-7000	7000	12,910	87.05	1.00	87.05	1.00	87.05	1.00	87.05	1.00
MOTOR 100-8000	8000	13,310	90.45	1.00	90.45	1.00	90.45	1.00	90.45	1.00
MOTOR 100-9000	9000	13,710	93.85	1.00	93.85	1.00	93.85	1.00	93.85	1.00
MOTOR 100-10000	10000	14,110	97.25	1.00	97.25	1.00	97.25	1.00	97.25	1.00
MOTOR 100-12000	12000	14,510	100.65	1.00	100.65	1.00	100.65	1.00	100.65	1.00
MOTOR 100-15000	15000	15,110	104.05	1.00	104.05	1.00	104.05	1.00	104.05	1.00
MOTOR 100-18000	18000	15,510	107.45	1.00	107.45	1.00	107.45	1.00	107.45	1.00
MOTOR 100-24000	24000	16,110	113.85	1.00	113.85	1.00	113.85	1.00	113.85	1.00
MOTOR 100-30000	30000	16,510	117.25	1.00	117.25	1.00	117.25	1.00	117.25	1.00
MOTOR 100-35000	35000	16,910	120.65	1.00	120.65	1.00	120.65	1.00	120.65	1.00
MOTOR 100-40000	40000	17,310	124.05	1.00	124.05	1.00	124.05	1.00	124.05	1.00
MOTOR 100-45000	45000	17,710	127.45	1.00	127.45	1.00	127.45	1.00	127.45	1.00
MOTOR 100-50000	50000	18,110	130.85	1.00	130.85	1.00	130.85	1.00	130.85	1.00
MOTOR 100-60000	60000	18,510	134.25	1.00	134.25	1.00	134.25	1.00	134.25	1.00
MOTOR 100-70000	70000	18,910	137.65	1.00	137.65	1.00	137.65	1.00	137.65	1.00
MOTOR 100-80000	80000	19,310	141.05	1.00	141.05	1.00	141.05	1.00	141.05	1.00
MOTOR 100-90000	90000	19,710	144.45	1.00	144.45	1.00	144.45	1.00	144.45	1.00
MOTOR 100-100000	100000	20,110	147.85	1.00	147.85	1.00	147.85	1.00	147.85	1.00
MOTOR 100-120000	120000	20,510	154.25	1.00	154.25	1.00	154.25	1.00	154.25	1.00
MOTOR 100-150000	150000	21,110	160.65	1.00	160.65	1.00	160.65	1.00	160.65	1.00
MOTOR 100-180000	180000	21,510	167.05	1.00	167.05	1.00	167.05	1.00	167.05	1.00
MOTOR 100-240000	240000	22,110	173.45	1.00	173.45	1.00	173.45	1.00	173.45	1.00
MOTOR 100-300000	300000	22,510	179.85	1.00	179.85	1.00	179.85	1.00	179.85	1.00
MOTOR 100-350000	350000	22,910	183.25	1.00	183.25	1.00	183.25	1.00	183.25	1.00
MOTOR 100-400000	400000	23,310	186.65	1.00	186.65	1.00	186.65	1.00	186.65	1.00
MOTOR 100-450000	450000	23,710	190.05	1.00	190.05	1.00	190.05	1.00	190.05	1.00
MOTOR 100-500000	500000	24,110	193.45	1.00	193.45	1.00	193.45	1.00	193.45	1.00
MOTOR 100-600000	600000	24,510	196.85	1.00	196.85	1.00	196.85	1.00	196.85	1.00
MOTOR 100-700000	700000	24,910	200.25	1.00	200.25	1.00	200.25	1.00	200.25	1.00
MOTOR 100-800000	800000	25,310	203.65	1.00	203.65	1.00	203.65	1.00	203.65	1.00
MOTOR 100-900000	900000	25,710	207.05	1.00	207.05	1.00	207.05	1.00	207.05	1.00
MOTOR 100-1000000	1000000	26,110	210.45	1.00	210.45	1.00	210.45	1.00	210.45	1.00
MOTOR 100-1200000	1200000	26,510	213.85	1.00	213.85	1.00	213.85	1.00	213.85	1.00
MOTOR 100-1500000	1500000	27,110	217.25	1.00	217.25	1.00	217.25	1.00	217.25	1.00
MOTOR 100-1800000	1800000	27,510	220.65	1.00	220.65	1.00	220.65	1.00	220.65	1.00
MOTOR 100-2400000	2400000	28,110	224.05	1.00	224.05	1.00	224.05	1.00	224.05	1.00
MOTOR 100-3000000	3000000	28,510	227.45	1.00	227.45	1.00	227.45	1.00	227.45	1.00
MOTOR 100-3500000	3500000	28,910	230.85	1.00	230.85	1.00	230.85	1.00	230.85	1.00
MOTOR 100-4000000	4000000	29,310	234.25	1.00	234.25	1.00	234.25	1.00	234.25	1.00
MOTOR 100-4500000	4500000	29,710	237.65	1.00	237.65	1.00	237.65	1.00	237.65	1.00
MOTOR 100-5000000	5000000	30,110	241.05	1.00	241.05	1.00	241.05	1.00	241.05	1.00
MOTOR 100-6000000	6000000	30,510	244.45	1.00	244.45	1.00	244.45	1.00	244.45	1.00
MOTOR 100-7000000	7000000	30,910	247.85	1.00	247.85	1.00	247.85	1.00	247.85	1.00
MOTOR 100-8000000	8000000	31,310	251.25	1.00	251.25	1.00	251.25	1.00	251.25	1.00
MOTOR 100-9000000	9000000	31,710	254.65	1.00	254.65	1.00	254.65	1.00	254.65	1.00
MOTOR 100-10000000	10000000	32,110	258.05	1.00	258.05	1.00	258.05	1.00	258.05	1.00
MOTOR 100-12000000	12000000	32,510	261.45	1.00	261.45	1.00	261.45	1.00	261.45	1.00
MOTOR 100-15000000	15000000	33,110	264.85	1.00	264.85	1.00	264.85	1.00	264.85	1.00
MOTOR 100-18000000	18000000	33,510	268.25	1.00	268.25	1.00	268.25	1.00	268.25	1.00
MOTOR 100-24000000	24000000	34,110	271.65	1.00	271.65	1.00	271.65	1.00	271.65	1.00
MOTOR 100-30000000	30000000	34,510	275.05	1.00	275.05	1.00	275.05	1.00	275.05	1.00
MOTOR 100-35000000	35000000	34,910	278.45	1.00	278.45	1.00	278.45	1.00	278.45	1.00
MOTOR 100-40000000	40000000	35,310	281.85	1.00	281.85	1.00	281.85	1.00	281.85	1.00
MOTOR 100-45000000	45000000	35,710	285.25	1.00	285.25	1.00	285.25	1.00	285.25	1.00
MOTOR 100-50000000	50000000	36,110	288.65	1.00	288.65	1.00	288.65	1.00	288.65	1.00
MOTOR 100-60000000	60000000	36,510	292.05	1.00	292.05	1.00	292.05	1.00	292.05	1.00
MOTOR 100-70000000	70000000	36,910	295.45	1.00	295.45	1.00	295.45	1.00	29	

Today's air power in action:<sup>®</sup>



Somewhere over California a Douglas C-133A heads East toward assignment.  
90th USAF MATS Air Transport Wing (Heavy) based at Dover, Delaware.

## This Air Force giant can swallow an ICBM

The new Douglas C-133A is the only jet age airplane capable of transporting both IRBM and ICBM missile systems. It dwarfs all other U.S. cargo aircraft in productivity, capacity and range, yet operates at the lowest cost in Air Force history.

This huge turboprop air freighter can safely lift 100,000 lbs. of payload more than 1,100 miles; it can transport 42,000 lbs. more than 4,000 miles nonstop. Its cargo handling costs are as low as 5¢ on both short and long haul

operations. It has the fastest loading and unloading time per ton of any modern airplane. Yet, despite its huge size and 420 mph speed, it can operate from short runways.

Because of its ability to move the point and missiles and their supporting equipment anywhere in the world in hours, the C-133A makes it possible to achieve a major increase in the effectiveness of our overseas bases while decreasing their size. It will buy more protection per dollar for the American taxpayer.

Coverage ranges held by the Douglas C-133A is capable of transporting the Air Force production DIRM THOR and all other current IRBM and ICBM missiles and their supporting equipment to U.S. bases throughout the world in a matter of hours.



"It more than pays for itself! The turbo-prop C-133A operates at a much lower cost per ton-mile and with far less flight and maintenance personnel per ton-mile than any other aircraft now in service. It is estimated that it will more than pay for itself in reduced operating costs alone in less than 7 years."

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#### DIGITAL RATIO METERS



### or a COMPLETE DIGITAL, MISSILE ELECTRICAL CHECKOUT SYSTEM

for measuring DC to 0.01%, AC to 0.2%, Ohms to 0.01%, DC ratios to 0.01% and AC ratios to 0.03%

Standard, off-the-shelf modules have proven reliability—provide economy, versatility. As needs change, simply upgrade old modules or add new ones. Your system is always current at minimum cost and engineering. Internal construction is like modularized TVI units of commercial design.

**Fully transistorized circuits** result in increased reliability, reduced power consumption, smaller size, lighter weight, compacted packages, and eliminate noise and fire hazards.

**Instrument case requirements**—Wiley, dynamic ranges cover all voltages from 100 microvolts to 3,000 volts, resistance from 10 megohms to 10 picohms. Input power frequencies from 50 to 400 cycles. New balance logic speeds down ranging. Automatic AC signal from 30 to 10,000 cycles. Use of transistors increases module life by a factor of three.

**Wide variety of input and output modules** for operating problems. IBM punches, etc., can be accommodated without modifications. All outputs are accessible at rear panels with connectors. With plug-in modules, digitized data is provided as printed form, punched cards or tape without modification to basic measuring instruments.



This Sheet From Electro  
gives complete specifications  
on both basic and auxiliary  
modules. Send for S-1, 10470.



**JETTISON** Jettison command station has six air actuators for longitudinal trim. Total travel is nine degrees of deflection angle. Speed brake serves in areas close to zero displacement.

cavities. Jettison circuit 10 lbf/mil force actuator rods on 48 in. centers. At a high density pressurized nitrogen it can move 22 lb gross weight lifting one of 51 side-profile seats. Ullage range over seat provides space of 736 cu in. Payload capacity of 4,000 lb is achieved with on-load densities of 6 or 7 lb per cu ft.

In addition to features previously cited, there are other advantages to mounting hardware on the test fixtage:

- Engine, seat sensors and rotating parts are located off aft cowl
- Air intake is protected by the wing from debris object ingestion
- Airframe structure is separated from cowl nose, avoiding ballooning, vibration and fatigue
- Engine, fan housings are isolated from airflow by front cowl or cowl. While uninstalled fans can result in poor heat load, should fail full loss of engine
- Rear engine layout enables for more substantial airflow spread pattern in field of compressor blades
- Passengers and ground personnel are immune from intake in jet blast damage
- During belly landing engine would not be subject to sheet impact

Jettison has had many acceptances low pressure (5 psig), two-profile engine driven fuel pump, and a modified fuel control unit. Fuel is delivered to boost pump via low pressure filter to engine driven pump which distributes at high pressure to overhead shutoff line, valve controlled control unit. Flow to engines is subject to automatic connection for engine start, instantaneous

at wing tip trailing edge. Inlet and air dump line is located above tail, hot line to prevent dumping below approx. altitude 215 gal.

Drop rate is about 15 to 10 gpm from each tank. System has positive saturation in averaging up to 250 psi, gas and liquid returned.

Airplane steel air system is located in aft fuselage, right side of aircraft and consists of two 17 cu ft spherical pressure vessels containing 19.75 lb air at 2,000 psi. Two safety relief valves set to open at 1,800 psi are located at high pressure manifold. Two air pressure regulators mounted on seats reduce high pressure to 200 psi for delivery to engine starters.

Ground start unit has seven core pressure and air flow through engine. This is automatic control of fuel flow to fuel system gas temperature during acceleration.

Fuel is transferred into sump tanks

in the motor-driven dual tank transfer pump.

Fuel switch is set at 150 gal.

Level indicator light shows an warning panel when sonic quantity falls below 50% (about 15 gal.).

**Dump System**

Airplane's dump system consists of a two-inch dump line extending from wing tank center through side and dump valve to dump chute located under aircraft.

Normal engine supplies 3 phase, 60 cycle, 115V power and is rated at 3,300 amp. Emergency generator (25kVA, 3000 ratings) supplies 3 phase, 400 cycle 115V power to essential bus only for



**B-5Bs Receive Between-Flight Maintenance**

Five Convair B-52 Hustler bombers receive between flight maintenance in experimental hangar at Ft. Worth, Tex., which accommodates one B-5B but could hold early production B-56 heavy bombers. Length of the B-5B is 97 ft; length of the B-56 is about 102 ft.

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### Rotodyne Flies With Complete Tail

British Army Rotodyne makes flight with complete tail. First flight of the transport was made without control surfaces on upper portion of the tail (AVN Nov. 15, 1975, p. 37). Rotodyne is powered by two Napier Eland propeller turbines, each rated at 3,580 shp. Air from engines passes through side blades, leaves with fuel in low density by pressure jets.

navigation and engine instruments, fuel quantity, oxygen, air conditioning controls and hydraulic pressure indicators.

• **System I** consists of automatic and manual no controls. System I is a snap type which interlocks all functions to maximize all modalities, except torque, bearing shells or determined by selected deadband ranges. Tank is mounted on top of compressor using Cognetti in 744 psi.

A star has three hydraulic systems.

• **System II** operates wing flap, speed brake, aileron and canard surface controls, leading gear, nose gear steering, braker. This is a constant pressure system using pressure as secondary sensor, and self-aligning pump driven by left air turbine motor.

• **System III** operates aileron and slat/rudder, right feel boost pump and speed brakes; may be used for wing flap and brake operation. Pump for this system is driven in flight or before start. System contains no sensor but no accumulator.

• **System IV**: Primarily purpose is to provide hydraulic pressure for operation of fuel boost pump for main engine starting. It uses an emergency source of power to assist starting. A 4411 dc motor is used to drive pump at 60 rpm, driven, connected in parallel with System I ATGM driven pump. System I hydraulic pressure is 1,500 psi when operating on System III pump.

System III pump does not provide enough pressure to retract gear or flaps. But gear extension is solenoid. As far as boost motor will operate on either System I or III pressure, should use the other fail.

Should the left engine fail with gear down, retraction cannot be made. Only one gear will retract, and flap. Main

gear will be partially extended. Engine gear gear extension is made via "T" handle on side of instrument panel. Gear will be held; airflow will lock it down.

Lockheed set a production record by parking the Javelin into the air within 34 weeks. It did this by forming a square team, under Corporate Vice President Kelly Johnson, and pooling it. Second prototype JetStar, N139K, of this series is about to begin a series of vibration fatigue flight testing at military extremes temperatures.

### Liquid Fuel Engines Use Standard Parts

Most propulsion techniques in the nozzle critical manufacture of liquid propellant rocket engines are utilized in accelerating donor propellants. In Reaction Motors, Inc., Dennis N. J. Company says that design emphasis and standardization of components permit the tailoring of engine systems to meet requirements of diverse designs.

The regeneration cooled propagation nozzle, based on a simple design approach, achieves significant weight savings through the use of standard, off-the-shelf materials. Separation logic required for nozzle closure can be by varying combinations of thermal chamber, initiator and booster rods, chamber pressure, pressure relief mechanisms and other factors.

Engines are suitable in surveillance and strategic applications, but Reaction Motors claims that its cost is low enough to permit them to be used in expendable vehicles. In regard to cost, availability and performance, the new liquid propellant systems are said to compete favorably with other engines.

### SOLID PROPELLANT ENGINEERS

Advances made in missile technology and space vehicle design have opened broad new fields for solid propellant rockets. Space Technology Laboratories has challenging positions in this field for engineers with five to ten years of experience in the design and development of solid-propellant rocket engines.

Inquiries regarding these positions are invited.

### SPACE TECHNOLOGY LABORATORIES

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This proud new Learstair, built for Solo Cup Company, Chicago, represents another triumph in aircraft engineering. Consider the high performance characteristics of both Learstar Mark I and Mark II. In every measure of altitude, power, payload, cruising speed and range, the new Learstar Mark I-A matches the famous Mark I — yet it is offered at a greatly reduced initial cost. Fully loaded, with a crew of two, ten passengers, and 700 pounds of luggage, this new Learstar can travel coast to coast non-stop at a speed of 250 mph per hour. Learstair is the only business aircraft that matches surface speed and range.

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a realistic view of corporate economy. If you now own or contemplate operating business aircraft, it will pay you to investigate the advantages of Learstar—how this superior business transport compares favorably with other business aircraft, both in original cost and economy of operation. For complete information, telephone, wire or write:

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LEI-A "straight ahead" cabin access measured in LEI-AIRSTAR Mark I-A instrument panel



LEI-A "cabin built to Solo Cup Co. specifications  
is roomy, airy, no cramped storage



LEI-A "passenger facilities are equal to many  
aircraft three times its size

rules which had passed tests were accepted alongside, was processed. Initial data from about 1,770 of the instrument tubes failed, compared with only 470 in the original trials. This marginal gain difference in failure rates does not justify cost of tools and scrapped wire, Varga says.

• **Project B**, consisting of visual-electromagnetic inspection, X-ray and polarized light examinations plus photoelectric test, resulted in scrapping about 75% of tubes in use evaluation. First test tubes that passed were installed in AN/ARC-37 airborne UHF communication equipment installed in Navy MD-type aircraft as well as similar numbers of unpassivated tubes drawn at random from NACA stock. After an initial total of 1,524 tubes were scrapped, Varga found the unpassivated tubes actually had a slightly lower survival rate than those that had passed the extensive inspections, i.e., 2.5% vs 2.1% per 100 hr operation.

• Project B also was run in another contractor with similar rejection of 17% of the batch. Tubes that proved were sent to K-Hausdorffpragmaticus vacuum levels in Air Force B-52s together with unpassivated tubes drawn from supplier stock. After an initial total of 1,313 tubes the operating team Air Force team found that unpassivated tubes had a slightly lower survival rate, 0.70% vs 0.71% per 100 hr operation.

Third batch of tubes consisting of units which had failed in pass one or more of the special project B samples but which were otherwise operable also were installed in B-57 bombing systems. Scrapping, this group, showed the lowest survival rate of the three sets. However, Air Force found that the number of tubes installed in the sample is too small to prove statistical validity. It therefore does not recommend use of test rejects for maximum reliability.

These tube inspection processing techniques, plus a fixed resulting set of thermal shock procedures, save selected



Cold Plate

Heat generated by power transistors used in ground and airborne electronic circuits is dissipated by means of a cold plate which transfers the heat from a primary thermal resistor to cooling air. Unit has been designed for Collins Radio Co. by United Aircraft Products, Inc.

AVIATION WEEK May 5, 1958

# LEWIS

Standard Temperature  
Indicators for Aircraft

USED BY LEADING AIR LINES, THESE INDICATORS HAVE PROVEN THEIR  
RELIABILITY BY YEARS OF SATISFACTORY SERVICE

#### THERMOCOUPLE TYPE



All LEWIS thermocouple indicators are fully self-contained, completely shielded and are available for use with iron-copperconstantin, copper-constantin or chromel-alumel thermocouples in all standard ranges for the thermocouple material used. A few typical ranges are listed below.

MODEL 178 175° max to AMR 1046  
—90 to +300°C Cylinder Temp.  
(AM 389-1A, m TIA)  
—90 to +300°C Bearing Temp.  
8 to 1600°C Exhaust Temp.

MODEL 416 175° max to AMR 1046  
—90 to +300°C Cylinder Temp. . . . .  
9 to +1000°C Exhaust Temp.

MODEL 718 140, 215° max to AMR 1046  
—90 to +300°C Cylinder Temp. . . . .  
—90 to +250°C Bearing Temp. . . . .  
(AM 389-1A, m TIA)  
—90 to +250°C Bearing Temp. . . . .  
0 to +1000°C Exhaust Temp.



#### RESISTANCE TYPE

Accurate measurement, these LEWIS resistors are remarkably free of voltage error, have nearly linear scales (not crowded at the ends) and are magnetically shielded. A few typical ranges are given below. Not shown is Model 4668, 250° angle.

MODEL 474 175° max to AMR 1046  
—70 to +155°C Oil Temp. . . . .  
0 to +155°C Oil Temp. . . . .  
—70 to +80°C Air Temp. . . . .

MODEL 718 140, 215° max to AMR 1046  
—70 to +155°C Oil Temp. . . . .  
0 to +155°C Oil Temp. . . . .  
—70 to +250°C Cylinder Temp. . . . .



FOR BEST RESULTS USE LEWIS THERMOCOUPLES AND LEWIS RESISTORS WITH THESE INDICATORS

**THE LEWIS ENGINEERING CO.**  
NAUGATUCK, CONNECTICUT

Manufacturers of Complete Temperature Measuring Systems for Aircraft

by Arinc as representatives of those used by industry. Arinc carefully planned tests to measure effects of external factors which might affect a low coefficient of reliability between processed and unprocessed tubes. Sample sizes were selected to provide statistically significant data.

Execution of Process A took place in the factory of the missile manufacturer that developed the technique, because of impossibility of obtaining data from actual missile strings. Arinc used equal numbers of processed and unprocessed tubes in identical types which were installed side-by-side in the same equipment.

In evaluations conducted at Air Force and Navy air bases, processed tubes were installed in specified sockets of housing, or communications equipment in lieu of the strength-unprocessed tubes in corresponding sockets of the other half.

Tubes measured during the investigations were later analyzed to determine the reason for removal in case if there was any significant difference in type of failures between processed and unprocessed tubes.

In the case of the missile manufacturer being Process A, Arinc found that samples of 95% of the tube materials were due to fatigue or stress relaxation problems, tolerances which was due to inadequate equipment design rather than tube shortcoming. Special processing tools for tubes could not correct this equipment design deficiency and thus at best could only not tube removal by 10%.

#### Tube Scrapping

The growth due to basic tube shortcomings (mechanical, electrical, metal fatigue) from the unprocessed tubes, and half for the processed tubes. However, samples were too small to provide reliable statistical conclusions that tube growth problem of over 40% Arinc believed. It requires the process of scrapping some 3,500 in special processing tools to reduce the number of tube defect removal from 10% to 6%.

Analysis of tubes removed from ABC's and R bending without during Process B investigation showed no significant differences in the types of tube fails between processed and unprocessed tubes, or failures that were rejected during processing tests.

Processed tubes used in ABC-27's experienced seven times as many tube defects due to the unprocessed tubes drawn from stock, but the former represented less than 5% of the total tube removal. Better objects also were slightly higher for processed tubes or mixed from Kinston in B-47.

On the other hand, processed tubes

## Simulator Tests B-58 Flight Controls



Figure 3-16. Hercules B-58 control system is tested on full-scale mockup simulator at Republic Fawcett Division of Bendix Aviation Corp. Test hydraulic ram used to return each B-58 closure, develop total torque of 246,000 in-lbs. Average of control surface deflection for given movement of pilot's stick is automatically varied over a 25.1 range in function of aerofoil air density and G-loading without pilot being aware of any change in stick feel. System includes automatic G-limiting function which prevents pilot from oversteering B-58's roll axis.



Coupled power assisted linkage used in B-58 flight control permits pilot to implement desired movements on coupled stabilizing, provides synthetic feel flight control input for a completely transversal amplitude 140 degrees, accepts a value of 2.2 in. at 4 ft. Static power assisted linkage features including altitude, Mach number, control aircraft has three response speeds the cover from 60 sec (IAW April 14, p. 14).



Measuring the bore of a steel liner ground in assembly with the case. Housing of the Shokrsky Z-800 compressor bearing. Its outer diameter is 1.000 in. and center must be measured with all forces and loads within no greater tolerance of plus or minus .0001 in. one minute and thirty seconds and with inner tolerances of plus or minus .002 in.

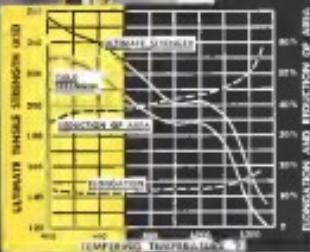
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# Newest advance in missile tankage

*A. O. Smith flash-welded and fusion-welded units have exceptional strength . . . can be furnished in sizes and configurations to meet your designs exactly*



Typical missile propellant tube as produced by A. O. Smith. Because of 40% weight loss, the highly stressed longitudinal welds at the cell and web junctions must be flash welded for maximum life and strength.

Here's a new opportunity to gain wider design latitude. A. O. Smith can fabricate liquid or solid propellant tanks (cylindrical or spherical) and pressure tanks to practically any chamber size.

A. O. Smith has produced tanks with guaranteed minimum yield strengths of 190,000 psi . . . wall thicknesses from 0.06" to .20" . . . diameters over 60" . . . lengths to 36'. Proposed designs and recent fusion-weld developments indicate temperatures and yield strengths of 210,000-235,000 psi are attainable in weld tubing.

For details on the A. O. Smith facilities and capabilities available, write direct.

Through research ... a better way

**A.O.Smith**  
CORPORATION

AERONAUTICAL DIVISION  
Milwaukee 1, Wisconsin

A. O. Smith Incorporated © A. O. Smith Corp., Milwaukee, Wis., U.S.A.

More than one hundred which will produce greater strength than the steel indicated above. Current data weight to strength ratio is 1.0. Tubes produced in the strength range indicated by the dashed line of the chart.

experienced slightly lesser strength and greater strength than the unpolished tubes from work, but the difference does not appear statistically significant, according to Avco.

Avco advances four possible explanations for the failure of quench preexisting tests to satisfactorily screen out potential tube failures and thus to improve reliability:

- Unstable annealing criteria. Test criteria used to determine which tubes are acceptable are unacceptable during special processing fail to duplicate accurately the criteria by which tube reliability is judged when tubes are used in ultimate equipment.
- Subjective testing fails可靠性

Procedure procedures which require human judgment, such as ultrasonic and X-ray inspection, lack uniformity and consistency. To illustrate the point, Avco cites an experiment where a group of 672 tubes were run through ultrasonic inspection three successive hours, without knowledge of the inspection. During the triple inspection, 156 tubes consistently were passed at temperature; 180 tubes were consistently rejected, but 172 tubes were passed upon re-inspection.

• Tests may induce useful life. Data suggest which results from handling and operation during screening tests may actually shorten the life span of potential trouble tubes.

• Forecasting does not solve design problems. For example, equipment failure caused by an inherently defective tube, Avco believes there are between three and 10 million tubes which should be attributed to tube defects which are introduced in design. If the test for tube integrity is applied in the circuit, if special processing does improve tube reliability, this improvement is masked by the propagation of tube failure resulting from encapsulation which may unaffected by tube screening.

#### Transistor Use

Although Avco's investigation was limited to vacuum tubes, it believes that the findings may be equally valid for special capacitors and diodes produced used with other base components. The endpoint lead toward using transistors has created a critical need for a much more detailed parameter problem and its objective evaluation.

The general problem, Avco's report says, is "Only in this way can it clarify and avoid resorting to the usual of special tests which sprung from inertia or remaining skepticism [which] can be a costly disappointment."

Copies of the Avco report, Publication No. 137, may be obtained from Avco's Reliability Research Dept., 1700 K St. N.W., Washington 6, D.C.



## SPIRATUBE helps keep jet's brains cool

Wherever planes fly, Spiratube is used for ground service support. Here it's used to keep the electronic flying and fire control brains of a Convair F-102A from overheating during ground tests. Used in conjunction with a Kico Air Conditioner, it helps keep the air at 30° or less and under approximately the same pressure as when the jet is airborne.

Spiratube<sup>®</sup>, a flexible, reinforced fabric duct, is used for this purpose because it is able to withstand abrasion and pressure and remains easily for storage in the compressor. (A 25-foot section of Spiratube retracts to 30 feet and forms a compact, lightweight, easily portable bundle.)

Flexible Tubing makes a complete line of flexible ducting and special shapes for the aviation industry. And the background and experience of our field engineers are always available. Say the word and we'll be glad to have one of them stop by to talk over your problems. For full information, write Dept. 205.

Represented nationally by Aero Engineering Co. and AlmetSupply Co., and by Associated Industries in Seattle, Washington.

**Flexible Tubing**  
Corporation

Gulfport, Connecticut

Anchorage, California

Biloxie, Mississippi

# T/I-transistorized 'peeping drones'



**see better  
fly farther**

**Transistorized radar**... and other Texas Instruments "electronic eyes" can ping the shape, location, motion, heat, and magnetic character of "targets of opportunity" ... relaying that vital data for action in those brief moments that the opportunity comes! In mission or mission-carrying microsystems aircraft, T/I's light, tough and compact electronics save fuel, space and weight while trimming maintenance and logistic problems.

Discussion of this advanced microsystems capability can be arranged on short notice. Authorized industrial or military personnel write or wire: Service Engineering Department ...

**apparatus division**

**systems management** — microsystems, systems control, software, mission analysis, reliability, communications, airborne sensor systems, navigation, atomic and solid-state optics, engine control, auto-vehicle sense, expert selection, information processing, data compression, microprocessors, space-oriented data, signal processors, transonic flow standards, and other precision devices.

**equipments** —

**research design development manufacture**

**TEXAS INSTRUMENTS INCORPORATED**  
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## FILTER CENTER

► **Solar Cells for Space**—New silicon solar cells with 10% conversion efficiency, suitable for aerospace applications, have range of -130°C to 500°C; order 75G (continuous) illumination and 100 G shock at DODG test duration, or even available from Semiconductor Division, Hoffman Electronics Corp. Application data is available by writing company at 932 River Ave., Harrison, NJ.

► **Russian-English Glossary**—Approximately 30,000 aerospace-related terms are listed in new Russian-English language translation and prepared by Air Force and now available from Office of Technical Services, Dept. of Commerce, Washington 25 D.C. The 204-page document, numbered PB 15169 "Russian-English Glossary of Aerospace and Meteorological Terms," is priced at \$7 per copy.

► **Transistor Sales Continue Climbing**—Semiconductor manufacturers sold slightly more than six billion transistors during January. Volume nearly twice the number of units sold during first two months of 1957. Dollar value was \$1.17 million, compared to \$9.3 million for same period of 1957.

► **Electron Devices Meet Scheduled**—Institute of Radio Engineers annual conference on electron devices will be held Oct. 20-21 at Sheraton Hotel, Washington, D.C. Papers intended in delivered papers should relate to topics such as: Acousto-Optics, Code 1240, Naval Research Laboratories, Washington 25 D.C. Papers should comprise developmental information and devices such as tubes and transistors, after they have emerged in circuit applications. IRE, sect.

► **Signal on Dotted Line**—Major contract awards recently announced by atomic manufacturers include:

- Sperry Gyroscope Co.—last received three Navy Bell Helicopter contracts totaling \$61 million. Largest contract, for \$39 million, goes to Sperry's Systems Area Division, Division of the Sperry Corp., Albany, N.Y.; AN/FWQ-2 guidance and navigation systems will be installed on Sikorsky model model ships. Second contract for \$1.1 million covers design and production of Matra 2 weapons director for tracking targets in Vought and Textron missile ships. Third contract, for \$1 million, covers production of Matra 3 computers for Fokker fighters.
- Westinghouse Electric Co. has sold 10 additional 200-ft. VOR-LOCuated stations to French government, bring

AVIATION WEEK May 5, 1958



**an expression  
of interest!**

General Electric's Jet Engine Dept., Cincinnati, Ohio, is now interviewing Engineers with 3 or more years experience in the following fields:

Mechanical Design	Aerodynamic Design
Control System Design	Control Component Design
Accessories Design	Mechanical, Electrical, Electronics
Cycle Analysis	Engine Performance Analysis

Please check your field of interest above, fill out the coupon below, and mail earliest to:

J. A. McGovern  
Jet Engine Dept. AW-57  
General Electric Co., Cincinnati 15, Ohio

This is not an application for employment; it is merely your expression of interest. Upon receipt of this coupon, we will forward a brief form to return to us disclosing your interests and experience. You may then be asked to visit Cincinnati, at our expense, to discuss with us, in a confidential manner, your future with the Jet Engine Dept. of GE.

### HERE IS WHAT WE OFFER:

- Opportunity to work with top engineers in a field in which you are most interested.
- Freedom to follow your own ideas.
- Pleasant working conditions and complete work facilities.
- Attractive salary plus 30 added days for better living, including Medical Plan and Black Thrift Plan.
- Opportunity to continue your education at almost all local Universities under our 100% tuition-reimbursement plan.
- Supervisorial supervision that recognizes ability and merit.
- Security, we are a prime contractor with the government, with long range contracts.

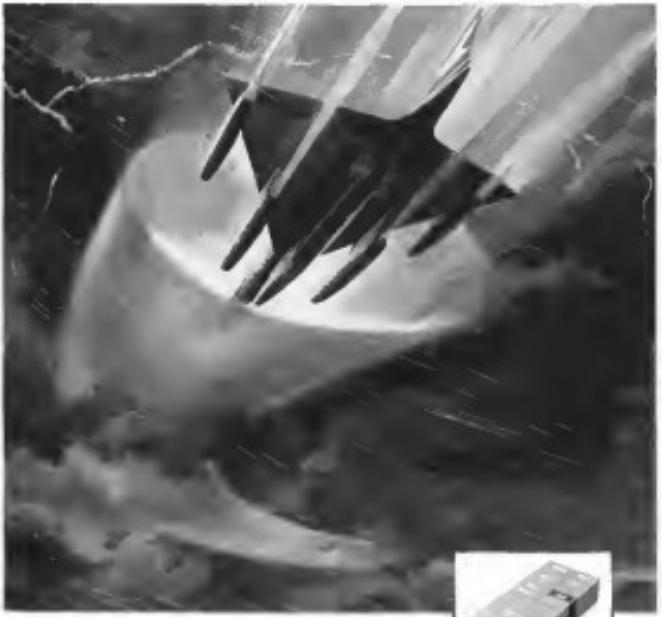
### Conferences:

I am interested in the possibility of an association with the Jet Engine Dept. of General Electric.

Name \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_ Phone \_\_\_\_\_  
Degree \_\_\_\_\_ College \_\_\_\_\_ Date \_\_\_\_\_

Be sure to Check Your Field of Interest Above. AW-57

**GENERAL**  **ELECTRIC**  
JET ENGINE DEPARTMENT CINCINNATI 15, OHIO



### NAVTAC: "Pipeline" to a happy landing

The transceiver of the new NAVTAC on route navigation and automatic landing system by Stromberg-Carlson is an combination of functional modules.

The NAVTAC equipment is an assembly designed to provide high-performance aircraft with the TACAN navigation and pilot marker beacon receiver, glide slope and runway locator for instrument landing systems.

The entire system is packaged in a compact unit only 9" high, 10" wide, 22" deep, and weighing only 47.5 lb. It should be able to be installed up to distances of several feet without any adverse effect on performance.

The equipment is designed to meet the rigorous environ-

ment of the high-performance aircraft of today and tomorrow. Its operating ambient temperature range is -40 to +125 degrees C at altitude up to 70,000 feet. Water-tight seal of environmental enclosure in the ILS receivers and TACAN entry ensure high reliability, small size and low power consumption.

Included in the design is the capability of performing complete preflight configuration tests with the use of a built-in test set.

Complete technical details on the NAVTAC system are available on request.

*There is nothing finer than a Stromberg-Carlson!*



**STROMBERG-CARLSON**  
A DIVISION OF GENERAL DYNAMICS CORPORATION  
1461 N. GOODMAN STREET • ROCHESTER 3, N.Y.  
*Electronics and communications products for home, industry and defense*



ment until it is packaged by Fokker. General Controls Electronic Controls Division has received a firm contract for development of data acquisition systems for use in remote sensor flights.

General Electric Light Mfg., Elgin, Equipment Department and Philco Corp. have received Navy funding contracts for continued production of Selenide infrared-guided anti-to-air missile. GE contract is about \$9 million; Philco's for about \$11 million.

Siemens Corp. of America expects \$184,000 development award from Wright Air Development Center for what company calls most advanced version of a military infrared reconnaissance system for use in high altitude reconnaissance missions. Company will build 10 units, make available to contractor.

Teletronix Corp. has received \$457,000 contract for all-weather infrared missile being produced by Martin's Orlando Division.

### Expansions, Changes In Avionics Industry

Cutter-Hansen, Inc., Milwaukee manufacturer of electronic components for aircraft radios, will expand its operations in Wisconsin Electronics, Inc., Milwaukee, Wis. If studies of both companies appear on May 26, acquisition will be accomplished through a one-for-one exchange of Cutter-Hansen stock.

Radios made in Japan. Except for earth, the only planetary body to supply the mass generated by any body more often than once is the moon. This is Japan which sends return moon boats varying both in time and frequency.

Solar whistlers. There has been advanced that the ion paths indicating that we propagated along the lines of a magnetic field to a conjugate point in the opposite hemisphere in about the same manner as earth's whistlers.

These signals are believed to affect earth and some periodic fluctuations of the earth's magnetic field.

Radar noise from meteors. Attempts to obtain confirmation between atmospheric phenomena and meteor noise have been made at 100 MHz and 10 GHz, confirming results of a Russian researcher who anticipated this as good that meteors generated noise. Further tests resulted in 10% correlation for systems that did not intersect the ionizing auroral bands, and 10% for systems spread a field of random numbers, cutting doubt on meteors as a source of radio noise.

Interplanetary hydrogen. Structure of the galaxy and large scale structure of the universe can be studied by determining quantity and location of the interplanetary hydrogen gas that is a major component of the universe. These measurements can be made around the 21 cm radiation of hydrogen in the interplanetary transition, but the signals are very weak and would be blocked if these band curves into arc.

Study of the effects of radio and solar reflections from the astros are being conducted by Stanford Research Institute under a contract from US AF's Rome Air Development Center. Most immediate purpose of the study is to determine problems that will be faced by users of the Ballistic Missile Early

Warning System which will be installed in the Arctic area, but effects on 16- and 24-GHz communications will also be studied.

Radio and radar signals at frequencies up to several hundred megahertz are reflected by ionospheric irregularities associated with the sun. Scattering experiments to take place at irregularities aligned with the earth's magnetic field line. Reflected signals are subject to rapid fading and large Doppler shifts, and an ionosphere when the sun is near a radio meets the magnetic field line nearly perpendicular.

Near infrared from planetary bodies can be detected as other thermal or non-thermal. Thermal radio noise is caused by noise generated by any body over a few degrees Kelvin and has been observed from Venus, Mars, Jupiter, Saturn, and the moon at centimeter wave lengths. Near infrared from a non-thermal source is called the earth, the earth itself or Jupiter.

No thermal solution from Jupiter is apparently centered on the metric wave lengths, occurring in intense bursts lasting about one second over periods from a few minutes to one or two hours, varying both in noise and frequency. The noise source is apparently centered in hot spots on the planet because the signals vary in relation to the period of rotation of the planet. Researchers at the Carnegie Institution at Washington who were trying the first attempt to find a radio source for the planet found the noise greatest at the "whistler" and "spot," but none in the east.

Harvard College Observatory astronomers have offered a theory suggesting that solar energy emitted from disturbances on the sun's surface are propagated as the "whistler" mode and reflect with earth's magnetic field in such a manner that the effect is a rapid periodic fluctuation of the earth's magnetic field.

While earth whistlers are propagated in the approximate frequency range of from one to four cycles per second, frequency of solar whistlers can be much lower, ranging a little less than 1,000, in the range from 0.1 to 100 cycles per second. Change in frequency would be very slow—the order of one to three cycles every 15 min. Signals of this type are believed to exist and to have been measured with amateur radioastronomers.

Research work on the subjects of radio noise from meteors and radio solar hydrogen has been carried on at Harvard College Observatory.

## Radio Noise Spectrum Concept Has Arctic Early Warning Value

Warning Systems which will be installed in the Arctic area, but effects on 16- and 24-GHz communications will also be studied.

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## Air Fleet Forwards Jungle Bible Work

By Erwin J. Sulhan

Vision Fleet of more than a dozen aircraft is putting the advances of a massive air service deep into the jungles of South America, comprising to approximately one fifth the time that would normally expand to bring the rank winds of civilization to primitive tribes.

Flying parrotas of this operation, a joint venture of Pan American World Airways and Radial Service (JAARS), which provides the safety and transportation needs of a widespread network of missionary hospitals of the World Bible Translators.

Jaars was founded in 1938 by W. C. Connon, Terrelland incorporated as a non-profit organization in Cuba, Mexico. Through an affiliate, Seminar School of Linguistics, the organization is dedicated to providing an accurate English language of the some 2,000 print native tribes in out-of-the-way areas of the world.

In the past two years, JAARS' airplane fleet, from Piper Super Cubs to a PBY Catalina, has flown more than 17 million passenger miles in the back jungle areas of Bolivia, Ecuador and Peru. Operation of Worldair is planned to the logistic in these primitive areas. According to the organization "To jungle areas Worldair cannot all enter faster than JAARS."

## Large Operations

This is one of the most vital large-scale aviation operations in the world consisting of more than 100 U.S. and Canadian pilots, many of whom are ex-service men who are also qualified air craft and engine mechanics. They work entirely without pay, as do all other members of Worldair, living on financial aid sent them by their friends. Help is sometimes supplemented by a special fund of the organization at times where outside aid is not sufficient to make up for minimum wages. It is estimated that the expenses of \$100 a month per man it requires to take care of each boy's worth.

Most of the planes get 40-60 flying hours a month. Despite the conditions and lack of air flying for the more basic aids, the organization has experienced only two crashes since 48 aircraft and in neither one were there any serious injuries.

Flying is primarily by time, dis-

ANOTHER ESSO "FIRST"



## The first approved oils for jet age airlines

A new era in aviation—turbo-jet engines are joining our commercial airline roster. Esso is especially proud that its Turbo Oil 10 was the first to be approved for use in the new Pratt & Whitney jet engines—and that Esso Turbo Oil 35 was the first to be approved for the new Allison Turbo-prop engines.

A decade ago, Esso Research anticipated the need for a new synthetic lubricant for aircraft turbine engines. Working with American and British designers and manufacturers, Esso Turbo Oils 10 and 35 were developed. Because these synthetic lubricants were used by manufacturers of jet engines in the development and testing of these new engines, they are thoroughly time tested and performance proved.

Esso Turbo Oils 10 and 35 were the first turbo oil to be

approved by manufacturers of the following commercial jet-pet and turbo-prop engines:

TURBO OIL 10      Pratt & Whitney JT-3d and JT-4      Boeing 707 • DC-8

## TURBO OIL 35

Allison 501	Laidlow Electra
Bell-Yeager Dart	Vickers Viscount • Fairchild F-47
Bell-Yeager Canary	Boeing 707 • Douglas DC-8
Bell-Yeager Arrow	Boeing 720 • Convair 340
Bristol Proteus 205	De Havilland Comet IV
Bristol Britannia	

You can depend on Esso—jet in quality and in service!

# TURBO OILS



ESSO RESEARCH works harder with oil



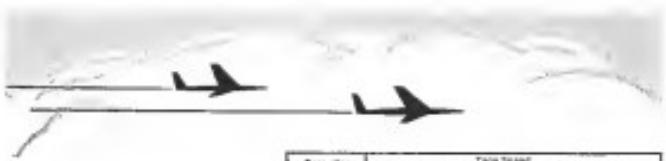
JAARS' HELICOPTER at typical jungle landing strip, in which deep in lesser and



DH-82, with which JAARS started in 1946, on camp at Peruvian base.



AEROMEXICANA Sedan freighter undergoing check at JAARS' Peruvian central base.



Recording Method	Data Selected				
	20	5	70	35	80
Fit Overlay	DC 290 cps	DC 500 cps	DC 1290 cps	DC 2000 cps	DC 6000 cps
Gated	200 cps	200 cps	200 cps	200 cps	200 cps (80)



## Airborne magnetic tape recording ...

**6-track... 60 minutes... <0.5 ft<sup>3</sup>**

When you need compact, lightweight magnetic tape facilities for permanently recording measurement and flight performance data . . . turn to Davis' Miniature Airborne Magnetic Tape Recording System. Here's optimum performance in an absolute minimum space and weight—ideal for any type aircraft or missile application . . . under any service conditions.

Separate remote power supply and optional remote control, interconnected by flexible cables, permits complete freedom in locating and mounting the equipment. All components, including the remote control box, total less than 22 pounds.

Yet, performance is king and ... no frequency-modulated-carrier channels plus a reference signal, or six direct-recorded tracks can be simultaneously tape.

width and transport speed, virtually any class of data can be recorded. As much as a full hour of 6-channel intelligence can be recorded using the new thin tape at 1200 ips. Frequency response in the various tape speeds, with both recording techniques, are shown in the above table.

Complete characteristics, technical information and application data may be had on this and other airborne and ground magnetic tape recording systems and equipment. Write Minneapolis-Honeywell, 10211 Illinois Street, Beltsville, Maryland.

Honeywell

H

DANIELS LABORATORIES DIVISION



**HOME SPACES** is the new site on **DESIGN FEST** Catalonia at Tarragona, people have

time, camped and checkpoints. Photo the route for navigation as much as possible, particularly when weather is marginal. Should it turn bad, prioritise a lead on the water (in case of first place), and work the weather out.

Major base of JAARS is in the Peruvian jungle some 100 km northeast of Lima across the Andes near a natural lake. Facilities include two masonry, approximately 1,500-ft. x 1,200-ft long and a concrete supply camp. All JAARS aircraft are brought here for overhaul and repair—performed by a crew of three. These operations, which may last, range from refueling or cleaning of the PBY's Pratt & Whitney R-1830 engines which are maintained by Compania de Aviacion (CASA), S.A.

Editor's Note

JAAKS' main techniques here also usually employ nuclear fuel for two reasons: commensurability in strength and by choice of designers for maintaining reliability. Overall, these are basically JAAKS to whom are attributed such a design that their weight of 150 kg is compared to original weight of 75-80 kg.

JAAKS developed 110% generator power-supply weight 45 kg. Experience shows that these units have a range of up to 400-500 m during the running mode, and 100-150 m during the start-up phase, then increased and improved steadily. Technicians are currently working on a program to transform standard units to save fuel of the gas-turbine-powered generators.

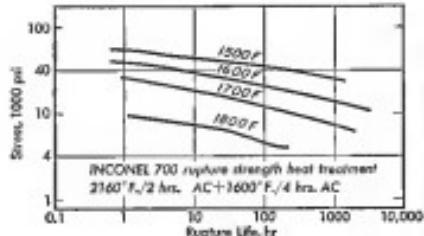
h on all its work. It stocks more than 2,000 varieties of seeds.

Chemicals arriving in the zone consist, in the case described, in 5,504 kg. weight of soft, white lead with malleability at room and 150°C. and with the following Microscopic examination of the sample shows the presence of a number of irregularly shaped particles of lead sulphide.



#### **Hellis Delivers First-Place STOL**

New five-blade version of Bids Courier ST650 business plane is shown climbing steeply after first takeoff run from runway at Westchester County Airport, N. Y. Recently certificated by CAA. For other aircraft info see accompanying STB600.



## New alloy! New strength!

Graph shows excellent stress-rupture strength of INCONEL "700" in 1500° to 1800° F range

INCONEL "700" age-hardenable nickel-cobalt-chromium alloy is a new heat-resistant material developed by Inco to meet stress and temperature conditions beyond the range of INCONEL "X"® age-hardenable nickel-chromium alloy. (Specifically, it goes beyond the operating temperature range of INCONEL "X" by 100°F for the same rupture strength.)

INCONEL "700" also has good corrosion and oxidation resistance. It can be forged, machined and welded.

### Availability

INCONEL "700" is available in forging quality rounds from  $\frac{1}{2}$ -inch to 2-inch diameter. Larger diameter bar is available on experimental basis.

### More Information

For particulars on properties, send for the INCONEL "700" basic data sheet. It gives graphs on yield strength, tensile strength, elongation; covers such data as composition, thermal conductivity and the like.

### Technical assistance

Inco has accumulated a great deal of knowledge and experience in heat-resistant materials which may be helpful in solving problems involving missile hardware. All the information and help we can give you are yours for the asking. Just write.

Specified Incoalloy

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New York 5, N.Y.



## What do these latest aircraft and missiles have in common?

All are equipped with **Grenco** flight control or instrumentation accelerometers.

What better proof of reliability?

With company reliability getting increased attention from missile and aircraft designers, it is significant to note the number of supersonic weapons remain equipped with Grenco accelerometers.

A complete list would be a roll call of tiered and strategic missiles and aircraft now in the nation's armament. Included are such weapons as the Atlas, Thor, Nike Ajax, Mace, Hercules, Bomarc, LaCrosse, Ballistic, Taurus, Dart, Matador, Gomor and Terrier missiles, and the F100 Super Sabre, F330 Voodoo, F111A, and Canada's CF105 Arrow. What better proof of the reliability of Grenco instruments than the acceptance by designers of these weapons?

Grenco product reliability with guaranteed delivery schedules and competitive pricing has made Grenco the fine world's largest producer of potentiometer-type flight and fire control accelerometers. More than 40,000 have been delivered to date.

Send for freeleaf data sheets on all Grenco Accelerometers.



**INCO NICKEL ALLOYS**  
NICKEL ALLOYS PERFORM BETTER LONGER

# CAPABILITIES . . . Manpower, Tools and Experience



## This Giant SPACE-AGE THERMOS Simplifies the Handling of Liquid Gases

How to transport hundreds of gallons of liquefied gases with maximum safety, maintain near-perfect vacuum and hold temperatures approaching 400 degrees below zero without the use of auxiliary refrigeration equipment? This was the problem successfully solved by Beechcraft engineers in only two months' time with the design, development, production, and delivery of the Beechcraft Dewar, first of its type ever produced.

Beechcraft scientists and engineers are at work on numerous projects involving transporting and storing of cryogenic liquids, plus projects in manyeronautics fields. A letter today to our Contract Administration Division will bring full information on how Beechcraft's five major plants, 1 1/4 million square feet of plant area, and 7,000 skilled craftsmen can help solve your research, development, or production problems.



# Beechcraft

BEACH AIRCRAFT CORPORATION • WICHITA, KANSAS, U.S.A.  
Steel Builders • U.S. Navy T-34 • USAF T-34 • U.S. Army U-20 • Beech • Travel Air • Twin-Beech • Super 18 Beechcraft Transport

plainly based at the start of takeoff.

Couch notes features of the Cessna, which is especially designed to move fast structural integrity of the cabin is crucial to an accident, is also a big factor in choosing the airplane. Metal panels noted were ready to withstand the impact of a hard landing on asphalt and the plane was crash tested. Crash tests were uneventful, she said. The cabin doors opened as easily as they would normally, indicating that the structure was sound.

Only major problem encountered thus far with the Cessna has been overheat of the freezing CG-515, according to JAARS' aviation superintendant. Cessna wouldn't let even 500 hr., although that was supposed to go for 800 hr., be used, and even the freezing technician couldn't find the problem. So JAARS is disassembling the Cessna engine cylinder and engine assembly to see if there is any problem. Although they do not go 2,000 hr. with this treatment, he noted. Maintenance personnel noted that they have no similar problem with other aircraft.

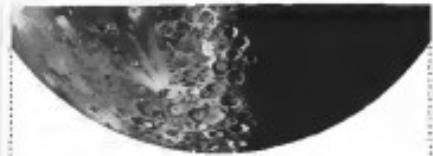
### Types of Operations

Major part of JAARS flying operations in the flying language specialists trained by the Sonnen School of Languages, comprising a family, sometimes with small children, sometimes a pair of young girls, into the jungles to live with the primitive tribes for six months at a time, in order to study their dialect first hand and attempt to evolve an accurate grammar so that the language can be translated into the Scriptures and that native speakers can be indoctrinated.

Airplanes also fly in all the material areas in the jungle, including food, medical supplies, and the fuel was in the equipment. A JAARS orbit brings in other necessary gear, coal and sometimes gasoline-powered refrigerators and occasionally brings out the oak and iron where necessary. Prevalence is for the first flight in month after month in the mountains with two weeks' supplies on one flight, then immediately make infrequent flights to build supplies up to a thermos' level. Then if missionaries are contact with each camp at least once a month.

At the end of the last year, the missionaries are brought back to the base camp to work on the material they have collected. They spend perhaps six months on that and then return to the village for additional periods as long as the job requires.

JAARS currently uses the services of more than 100 people traveling in these areas, including members of other mission air or religious groups. Post Four Interdenominational, intercultural and intercivic foreign citizens having houses in the areas it operates. In Peru, for example,



Specialists wanted for study and research on

## Nuclear Rocket Engines

This is an outstanding opportunity to join Rocketdyne in Air Force study and research activities directed toward a nuclear rocket engine.

You'll work with Dr. H. E. Dillaway, one of the nation's foremost nuclear propulsion scientists.

Please check the following list of positions now open in missile feasibility studies and preliminary design:

**1. Senior Engineer Research or Engineering:** Nuclear power in air vehicles. M.S. or equivalent; experience for basic studies in the application of nuclear power to air vehicles.

**2. Senior Engineer Research:** Nuclear Engineer, M.S. degree or equivalent, with a background in unconventional powerplant designs.

**3. Research Engineer:** B.S. degree in nuclear engineering. College work in general powerplants desired.

**4. Engineering Specialist or Senior Engineer Research:** M.S. or equivalent, with a strong background in hydrodynamics and fluid mechanics to study sonic relationships of propellant equipment for rocket engines.

**5. Senior Engineer Research or Engineering Specialist:** PhD, desired with a background in nuclear energy, serve specimens, controls or instrumentation. Should have preferably 4 years additional experience.

**6. Senior Engineer Research:** PhD or M.S. degree with a background in heat transfer relating to gas or liquid cooled nuclear power plants, preferably of aircraft type.

**7. Senior Structural Engineer or Stress Analyst:** Several years experience in mechanical stress and structural analysis. M.S. or B.S. degree or equivalent.

Please direct your inquiry to Dr. H. E. Dillaway,  
Nuclear Propulsion Group  
6033 Conga Avenue, Canoga Park, California.

**ROCKETDYNE**

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it is observed by the no-fare military air transport service to provide air service where there is no other way of getting around. Surface travel is so difficult it can take three to four weeks to reach some areas, while an airplane gets to the same place in hours. When persons not belonging to the Wyndham organization are invited, the charter provides them with assistance in an event of accident, normally JAARS carries an entire life equipment kit.

Occasionally JAARS also supplies short-term services to companies flying in the area. In one case it operated a petroleum company's Catalogue for an oil company which found its pilots wouldn't handle the job for a nominal fee of \$125 a month. Millions involved considerable flying over mountainous terrain.

#### Fuel Consumption

JAARS operations last year consumed some 45,000 gal. of aviation gasoline—91 octane is standard. Its main FBY is about equal to a regular jet airplane gas engine along the rivers; in the hills the organization operates two engines at 100% to lift the Catalogue with 1,115 cu. ft. of fuel, then all storage amounts at the various cathes.

Cathes is used in flying heavy loads long distances. In Bolivia, for example, it carries sufficient fuel from a community's garage to purchase an aircraft permission to use the airplane after that dinner. The Catalogue

simple, it was possible to set up a base with only two flights is the FBY, saving an estimated three years in getting material to the spot.

Where does it get the equipment and funds to operate? All the money is donated by businesses, organizations, clubs, churches and interested individual folks.

#### Donated Equipment

Some equipment is loaned, but most is purchased by JAARS but from their unique source of resources. In the case of the Catalogue, 90,000 miles in the Andes, the organization's first flight began in August, the local folks being so kind. Give Wyndham your share of the Catalogue 150 rods and our partner will be the passage. And the partners invite the other to Wyndham, which had enough funds to buy the passenger half ownership.

JAARS' motto is simple: "We put God on the spot and he delivers." Only a little more than a year ago it availed two Hello Greetings—it now has a full-blown experts to get another soon and is campaigning to get more of the \$25,000 STOL airplane for operations in the Philippines and New Guinea.

When it receives sufficient funds from a community's garage to purchase an aircraft permission to use the airplane after that dinner. The Catalogue

## Controls Development at Marquardt



By  
Ray E. Marquardt,  
President

Marquardt was established in early 1946. Concurrently with the early development of the ramjet engine, controls had to be designed which would operate within the ramjet engine under severe environmental conditions.

The extreme velocity and nonstationarity of the engines required controls requirements well beyond the limits of the techniques then developed and available.

Marquardt engineers and scientists solved these early control problems... creating components which provided remarkable performance in the high Mach engines, and today under Chief Engineer Tony Klossner have gone on to develop a family of ever more advanced controls and actuators.

In related activities, Marquardt's precision motion and power work has advanced in emergency power units for the Chance-Vought F8U-1 Crusader, and the Lockheed F-104 Star Fighter.

In the area of aerospace applications, Marquardt engineers and scientists have been engaged in basic research and development programs for the past ten years. This aerothermics knowledge coupled with our controls background has led to applications for missile, planetary and orbital systems on North American's Bound Dog electronic communications satellite and McDonnell's two-engine all-weather fighter.

And in aeronautics materials, art materials, space transportation and nuclear sections, Marquardt engineers have and continue to achieve significant engineering breakthroughs.

Professional engineers will find a broad range of challenging assignments and projects at Marquardt, plus opportunity to further their career through professional educational programs.

For information about the professional engineering opportunities at Marquardt, we invite you to contact Jim Dale, Professional Personnel today.

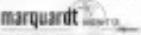
*Ray E. Marquardt*



## To Controls Engineers Facing an ENGINEER|BARRIER\*



**Marquardt Means Opportunity**—Controls Engineers with a desire to work on projects involving aircraft, missile, planetary and space programs need Marquardt Aircraft, the company whose success in aircraft design has never equaled. Here an experienced engineer in an environment you will work with a management staff committed and rewards the contributions of engineers. Look for opportunities by looking to Marquardt today. Address your inquiries to Jim Dale, Professional Personnel, 21012 Marquette Street, Van Nuys, Calif. 91406. Phone 401-4114.

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Marquardt Aircraft Company  
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### Monte-Copter Flies New Configuration

Latest version of paramotor-powered Monte-Copter, shown during test flight at Boeing Field, Seattle, Wash., has completely covered fuselage and new tail. Earlier prototype (AW Mar. 31, p. 40), was uncovered, featured twin finned tail surfaces. Two Continental 140-hp engines are mounted in pods on each side of fuselage.



**FLY WEATHER-WISE** — **Mobil**

These weather maps prepared in consultation with the United States Weather Bureau

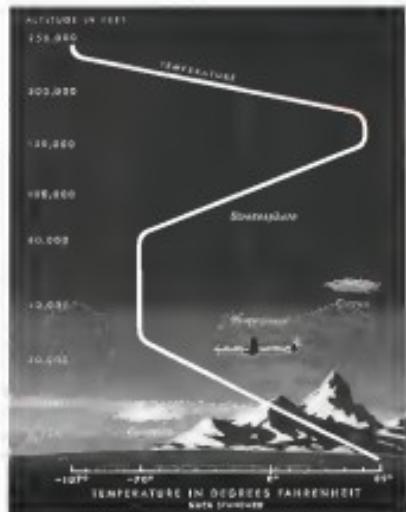
# TEMPERATURE VARIATIONS IN RELATION TO ALTITUDE...

TEMPERATURES ENCOUNTERED in a single flight trip vary as much as 150°F or more. These variations are associated with altitude and weather patterns and can affect flight performance.

**Temperature and altitude**—Heat from the sun warms the atmosphere with steadily decreasing effect as altitude increases. Temperature actually decreases with altitude at the rate of 3.6°F per 1000 ft. At the tropopause (top of troposphere) temperature remains almost constant up to 40,000 ft. Therefore, modern aircraft encounter colder air in the tropopause layer which varies from about 30,000 ft in the polar air masses to about 40,000 ft in the tropical.

An altitude increase from approximately 30,000 ft to 350,000 ft., the temperature remains to about sea level conditions. That is the result of strong absorption of the sun's direct rays kept in the layer of ozone gas at very high altitudes.

At still higher altitudes, the temperature turns to extreme cold.



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ernments contribute to the extent of  
their limited resources, but you the  
American government donated 40,000  
gt. of fuel to JAVARS.



**YAK-18P** has top speed of 174 mph

## Russians To Produce Yak-18s in Quantity

Two new versions of Russia's single-  
engined Yak-18 trainer have completed  
flight tests and are slated for quantity  
production.

Both planes—the Yak-18P and Yak-  
18M—feature substantial improvements  
in design and performance over their  
predecessors and will be delivered to the  
Red Air Force and to some units  
operated by the U.S.S.R.'s large, amateur  
DOSAAF (Volunteer Society for Cooperation  
with the Armed Air Forces and Navy).

\* **Prototype** Yak-18A has a maximum  
speed of 161 mph, at sea level, service  
ceiling of 16,097 ft, and normal range  
of 466 mi. With medium fuel loads,  
range can be increased more than  
2,450 mi.

Major point of the Yak-18A, second  
to Soviet exports, is its high rate of  
climb. It can reach 3,281 ft in 30  
seconds. Takeoff speed and maneuverability  
are better than for the  
Yak-18.

\* **High-speed** Yak-18P has a top speed of  
174 mph and severe cockpit at  
21,982 ft. Takeoff run is 794 ft and  
landing distance using brakes and flaps  
is about 4,156 ft.

Yak-18P's track landing gear is  
fully retractable, while the Yak-18A's  
is only semi-retractable. Both craft are  
low-wing monoplanes powered by an  
isolated, radial engine. They have two-  
way radio and all-weather navigation  
equipment.

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one of them the X-14, have been flown successfully,  
and an operational aircraft is now being designed  
for the United States Navy.

Expansion of this VTOL program has created openings  
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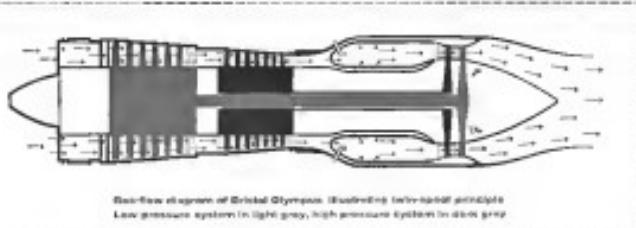
BRISTOL. Power for the Wings of the World—No. 4

# BRISTOL OLYMPUS

POWERS THE

# VULCAN

Twin-spool Olympus gives British V bombers  
great speed, high ceiling, long range



Basic diagram of Bristol Olympus. (Bristol's twin-spool principle:  
Low pressure system in light grey, high pressure system in dark grey)



The great Avro Vulcans of the British Royal Air Force are powered by Bristol Olympus turbines. These V bombers owe their great speed, high ceiling and long range largely to the Olympus—an engine which uniquely combines great power at high altitudes, very low specific fuel consumption, and exceptional, proven reliability.

The British Under Secretary of State for Air, Sir Charles F. Ormsby-Gore, has stated: "The Vulcan has probably had the minimum amount of testing trouble of any aircraft introduced to the R.A.F. over the last 10 years."

**Bristol two-spool system.** The Olympus employs the Bristol patented two-spool system. This system isolates the high-pressure, compressor stage, and gives a rapid responsive control. Vulcan pilots regularly put the Olympus through "shock" penetrations and dislocations at altitudes well above 30,000 ft.—one of the most severe tests to which a turbine can be subjected. The Olympus responds magnificently every time.

**Latest version.** The Bristol Olympus Mark 200 is type tested at 24,000 lb thrust—without reheat. It is now in production for the Vulcan B2 Mark 2 and gives the bomber even better performance. A third version of this superb—the Wright J79 Repulse—has been jointly developed by Bristol and Curtiss-Wright.

**Olympus development.** The Olympus is capable of development into the 30,000 lb thrust class. It has already run at observed thrusts of over 17,000 lb without reheat.

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PUSHER propeller has reverse action.

### Russian Snow Sled Uses Aircraft Engine

A propeller-powered Russian snow sled built by helicopter designer N. I. Kaman for surface transportation over snow and ice in the far north has recently completed its tests.

Vehicle consists of a standard Soviet Pobeda automobile-chassis which mounted on runners. On top of the car body is a two-bladed propeller. The engine is a four-cylinder 140-hp (104-kilowatt) Lyulka (Little Bird) shaft-driven aircraft transport plane.

A two-bladed, controllable-pitch propeller provides forward motion and braking. However, the propeller can furnish reverse thrust for backward movement.

Russia reports that the Kaman tested is more powerful than similar Soviet-built earlier vehicles which didn't provide even minimum comfort, were short lived, and had many operational troubles. The Kaman model is said to be as comfortable as a passenger car and can be operated by one person with a two-bladed propeller.

Space originally intended for the automobile engine is used for baggage loads with a fuel capacity sufficient for five-hour operation. Loads located under the car's front fenders.

Sled is equipped with a special heater unit to warm the engine before starting.

It also has the car's cabin which functions and can serve the rest needs of the team if they should become frozen while the vehicle is stopped.

### PRIVATE LINES

Test program for Russia's bi-engine Antonov An-14 "Moloda" (Little Bird) short-haul transport craft for approximately 35 flight hours. An 11-made its first flight in mid-March (AVW Apr. 21 p. 45). Standard version will carry 20 passengers and 350 lb. of baggage for 375 mi., a proposed cargo model will carry 1,300 lb. payload up to 625 mi.

Executive versions of Lockheed T-27 turboprop transport are now scheduled to go to following: Continental Cos Co., General Tire & Rubber Co., Bell Helicopter, Bank of Mexico, Wyoming Electric Corp., Cheyenne Spur Ranch, Inc., and the U.S. Forest Service and Idaho Congressmen. In all, 14 T-27s have been ordered for private use. Lockheed has total of 45 orders on books for R-27s, including airline types.

Half-dozen separate serial series contracts covering some 60,000 sq. mi. of Bolivia have been awarded. Canadian Mining Group is several international oil firms. Amount of contract exceed

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## A message for young physical scientists & engineers

from James H. Doolittle, Chairman, NACA

Futur breakthroughs on crucial problems relating to aircraft and missiles can be expected in light of NACA's long record of achievement. NACA supplies advanced research findings to the Nation's aircraft and missile industry, to all branches of the military, and to the airways. All Americans can be assured by the knowledge that NACA is working with a spirit of urgency to help solve the current most pressing problems of flight.



James H. Doolittle  
Chairman, NACA

James H. Doolittle Chairman, NACA  
Dr. G. M. Meissner Director of Technology

NACA has a staff of 7,750 research scientists and supporting personnel spread among centers on both Coasts and in Ohio. NACA staff members in pursuit of new knowledge have available the finest research facilities in the world, including several of the largest and fastest supersonic and hypersonic wind tunnels, jet jets, a fleet of full scale research airplanes, which will include the X-15, hypersonic ballistic ranges, shock tubes, a nuclear reactor establishment, rocket facilities, a research missile launching site, tracking devices, and the most advanced insulation and electronic computers.

NACA Fields of Research include Aerodynamics, Aircraft and Missile Structures, Materials for Aircraft and Missiles, Automatic Stabilization, Propulsion Systems, Propulsion System Structures, Rocket Systems, Solid State Physics, Fuels, Instrumentation.

A number of staff openings are becoming available. You are invited to address an inquiry to the Personnel Director at any one or all four of the NACA research centers:

Langley Aeronautical Laboratory, Hampton, Virginia  
Ames Aeronautical Laboratory, Mountain View, California  
Lewis Flight Propulsion Laboratory, Cleveland, Ohio  
High-Speed Flight Station, Edwards, California

(Persons are listed as members and the Associated Research Board Assessment, 1970)



The Nation's Aeronautical Research Establishment

## WHO'S WHERE

(Continued from page 25)

### Changes

John Clegg, manager newly established Defense Systems Support Department, North American Aviation, Inc., Los Angeles, Calif.  
Edwin A. Rausch, manager, Dynamics Division, Wyle Astronaut Corp., El Segundo, Calif.

Orville Bishop, manager, Particle Beam Corp.'s station products branch, Los Angeles, Calif.

George E. Makinson, manager, general and staff Polar project, Metal Systems Division, Lockheed Aircraft Corp., Sunnyvale, Calif.

Silvey J. Nelson, aerospace flight operations test and Walker E. Rose, senior flight engineer, TRW Incorporated, P. O. Box 4000, Redwood City, Calif.

R. A. Gott, Windtunnel, P. O. Box 4000, Redwood City, Calif.

John H. Wessel, manager, director, Van American Wind Tunnel Service, Westerville, Ohio.

John E. Campbell, manager procurement, old Government and Industrial Division, Philco Corp., Philadelphia, Pa.

Bert Atkin, Prod. Systems Taylor, Jr., USN, ret.), director Washington, D. C. operations, Patchell Company and Justice, Inc., Falls Church, Va.

Beck A. Yost, vice manager, Technical Products Division, Pechell Bell Electronics Corp., Los Angeles, Calif.

Col. I. G. Martin (USAF, ret.) and consultant, National Research and Development Corp., Belmont, Mass.

Robert C. Johnson, vice manager, Lockheed Const. Div.-1, Steven International, New York International Airport, N. Y.

Beth A. Wilson, recently promoted, product manager, Metals Application Department, Tools Institute Division, the Electric Specialty Co., Los Angeles, Calif.

Roy S. Shulman, recently promoted manager, and Martha W. Ulrich, experimental and development engineering manager, Airframe Division, Latex Manufacturing Company, Costa Mesa, Calif.

Barry A. Murphy, senior project engineer, engine component design, Solid Propulsion Engine Department, Aircraft Gas Turbine Division, General Electric Co., Cincinnati, Ohio.

H. Devil Bissell, managerial sales, and Arthur C. Conner, customer contacts, FTE Control Divisions, Co., Portland, Ore., Pa.

James R. Goran, chief consulting engineer, Technical Projects Division, Wyle King Corp., Los Angeles, Calif.

Marie Robin, recent purchased profile, Wright Engineering Co., Van Nuys, Calif.

Maj. Gen. Samuel S. Beck, Director of Services at Headquarters Marine Corps, will move to Marine Corps Air Station, El Toro, Calif., in Deputy Commandant, Air Task Force, Marine Forces Pacific, Maj. Gen. G. Morris, Assistant Chief of Staff, Marine Aircraft Wing at Cherry Point, N. C., will replace Gen. Beck as Director of Services.

# Engineers: work in dynamic science

North America's Columbus Division, home of the T-22 jet trainer, FJ-4 Fury Jet and ASJ attack weapons systems, is rapidly expanding its Dynamic Science Section. New aircraft, missile, and research contracts have created excellent career opportunities in these fields:

**AEROELASTICITY:** Work entails making measurements, vibration analysis, flutter and vibration, evaluation of preliminary designs to determine from an aeroelastic standpoint the effects of structural flexibility on aero load distributions.

**DYNAMIC TESTING:** You'll be assigned to test facilities in laboratory and wind tunnel, determining the effects of ground and flight vibration on complete systems, and measuring flight vibration in reproduced environments.

**DYNAMIC ANALYSIS:** Perform analyses on the effect of aero, blade, and carrier excitation on the aeroelastic response transonic level. Apply a generalized harmonic analysis to vehicles that encounter supersonic bodies. Ascertain the effects of flexibility on structural response characteristics.

**ANALOG COMPUTING:** Work on the development of scaling techniques, circuit methods...combine scaling-circuit operations by applying differential analysis techniques.

Applicants with at least one degree and related industrial experience are invited to write or apply to:

Engineering Personnel  
North American Aviation, Inc.  
4500 East Fifth Avenue  
Columbus, Ohio

THE COLUMBUS DIVISION OF

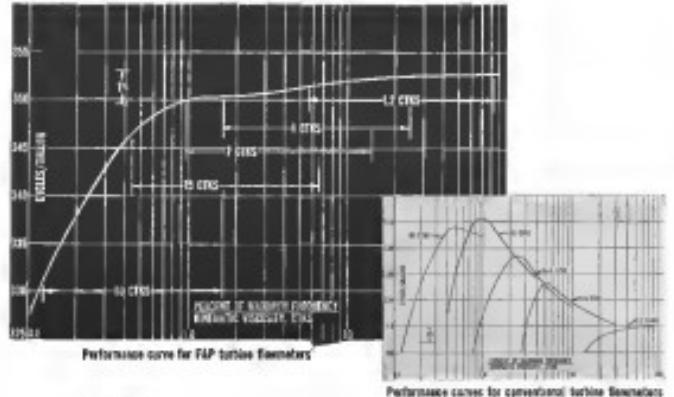
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## LETTERS

### Helio "Courier"

Your columns excellent article of March 17 (p. 35) on the Disaster Dec. 27 assumed that the purpose was a honest mistake in STOL operation of the plane—Finals Crash. Klein-Douglas, etc., but we accountable account sources of the White House—CIA, FBI, etc., who were present at the time of the crash, say that the purpose was to test the aircraft's performance in landing at low altitude and in the going down in 15 minutes including our this, as fast as we could get it done.

Ronald L. Danner, Jr.  
Chief Technical Writer  
This Month Corp.  
Norwood, Mass.

### Safety Responsibility

As an engineer, the nation's reliance of a F-117 and a C-119 over Novosibirsk, Russia, has caused me with a desire to share my thoughts on our safety with those of you

I believe the aircraft industry, as the creator of the aircraft, must share in the responsibility for safety of human lives and correct simple measures to minimize potential problems.

There have been made talk and even laws and codes formed to do just that, but as far as safety is concerned, we still face the problem of the "jet age." Now we try to design a system to end it in a manner that the same procurement agencies that were unable to cope with the problem of the "jet age" will have the full. Shall we stick to levels as the same and as they already a great many years ago?

I would like to congratulate the aerospace industry on the excellent progress made in communications, safety, pressure warning and other equipment which greatly enhances the safety of flight. It is obvious that there is still much more work to be done to develop and refine. The structural designs and reliability of our aircraft have been developed as a non-pilot system. But the human element has remained and even expanded to greater and greater standards.

These decreases are 100% due, I believe, that only they can the pilot be caused. Until that time progress must also be made in improving the pilot's visibility and navigation. Let this so that he can devote a reasonable amount of time to watching out the side of the aircraft and not the front in making aerial navigation in particular cockpit visibility. The B-747 is as excellent example of the capability in a large aircraft. What advances have been made in cockpit visibility of transports since the F-104. In general, though, we should have long range when flying in the cockpit have a camera, showing the passenger, pilot, etc. three-dimensional speed and comfort must be secondary. We can give the pilot the integrated site piloted display, being developed for the next few years.

I would like to applaud Attorney Meyer as the modified addles as an adviser and especially the transport stability meetings

which *Worrell* envisions the position of its readers on the issues raised in the congressional editorial columns. Address letters to the editor, *Washington Week*, 2300 F St., N.W., Washington, D.C. 20007. Letters from readers under 500 words will receive a greater identification. We will not print anonymous letters. We reserve the right to withhold any request.

One other the *Guard Courier* states: The letters have been presented and an option to provide pilot life myself. I believe that the safety checklist must require design of all aircraft. They have probably not adopted the NTSB's suggestion or may need for the want to keep the public concern of design.

The public is aware of the Guard Courier and the Novosibirsk disaster. We, in the duty performing aviation, must retain a sense of responsibility. We must be able to expect to self-analysis to the letter, now.

Kris Serrato  
Folsom, California

### Reserve Cuts

During the same period of making our Reserve Force cuts, which will reduce the number of defense personnel has not been accompanied with the reduction in the number of defense officers. This is a most qualified service officer who has spent a large percentage of their working lifetimes as the source of their career path to be reduced and thus area due during these more difficult implementation year without any of the security benefits which sometime come with the position of a senior officer. I would like to emphasize please take due consideration.

Since the reasons for reducing technically trained personnel has been determined by the President of the United States, State and House investigating committees and the Senate Select Committee on veterans that action is responsible is highly questionable. Responsible police officials throughout the free world have indicated that our military does and will depend on an increasing requirement for a technically trained personnel to maintain our strength. The Congress is now considering increasing a pay bill to every one, the primary requirement of retaining skilled personnel is the second. Large numbers of students are being introduced to federal apprenticeship to fill the gap, and for technically trained personnel to maintain our strength in terms of electronics engineers, special weapons officers anderonautics engineers have place to satisfy a part. Fourth, Whiteman's role in our defense expenditures in reducing the personnel of listeners within the defense department.

The third, which I believe is the greatest threat, budgetary cuts, finally reduced personnel the absolute loss of technical and experienced officers, the distinction family disappears—one of these resulting measure does have taken the Pentagon or the White House from these requirements that the action is sensible and important and the completely expressed need for the greatest possible retention of trained tech-

nical people. Even Rep. Carl Vinson through the House Armed Services Committee has failed in concern the Pentagon of its needs.

An unestimated crisis in this wrongful administrative actions, it seems that your publications might be interested in writing the committee against some public opinion against the date of the cutbacks and perhaps to some degree favorable report the hearings now scheduled in early October. The House Armed Services Committee following the Enter recent letter when these efforts to date imminent.

Ronald J. Pinsky  
St. Albans, Vt.

### Whitewash

The ALPA protest against the findings of the CIA's file on the Rikas trial (AW, April 14, p. 11) seems to be no whitewash in whitewash. Capt. Maule's fall was no whitewash.

Capt. Maule met his primary concern was impact, rate of climb, and direction. The three instruments referred to that are most commonly used to classify to report them as proper instrument landing procedures.

I am not familiar with the instruments found in the RIC-B, but as a rule the so-called "primary flight instruments" are mostly or almost or not least pilot static. I can still hear my mother's constant chiding "needle, ball, needle, ball."

With proper reference to these three instruments and the glide horizon (up right side), the craft could have been diverted.

H. E. Sorenson, Jr.  
Lt. USAF  
Watertown, Mass.

### Relative Motion

Having noted the difficulties involved in the development of the Collision Warning System, I suggest that one important area in being developed is the lack of relative motion of the other aircraft as viewed by the pilot, or second as collision course will reflect their angular displacement as viewed by the pilot and gain in use. This lack of motion appears to be the reason why a maneuvering aircraft will be seen as a much greater distance than the one whose position is relatively fixed.

Now if certain methods of measuring motion images from radar screens could be devised to detect the motion (in bearing and range), range, date would be left a precise rate of motion.

This could definitely help make better long range detection as it would also allow faster that uses what directly as distance.

This system would have some limitations such as aircraft flying in parallel across whose range of the system and overall its ingenuity flight paths.

Bruce E. Casner  
Edenland, Fla.

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new unified  
fastening concept*



**Fastbolts and Fastsets** are available in a wide range of materials including alloy steels, general tension alloys, stainless steels, super alloys, chrome die steels and aluminum alloys.



**VOI-SHAN**  
MANUFACTURING COMPANY  
a division of WILCO MANUFACTURING COMPANY  
8402 Higgins Rd., Culver City, Calif. 90230

# How ESNA® solves 7 typical aircraft fastening problems



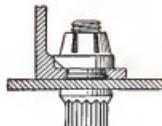
## Speedier installation of access panels

ESNA gang channel nut strips eliminate the costly, time consuming installation job of riveting individual nuts. Available in straight or curved sections and even complete rings, custom designed for applications such as access doors or inspection covers.



## Bolting non-parallel surfaces

No more costly spot facing, step milling or hand selecting tapered shims! ESNA's counterbored, self-aligning types include one lug, two lug, gang channel, standard hex and high tensile types. Ball-and-socket relationship of nut and special base allow an 8° tilt in any direction from centerline to compensate for draft angle or tapered sections.



## Fastening stressed joints subject to temperatures up to 1300°F.

For really "hot" applications such as jet engine flange assemblies or fire wall sections, where fastener dependency is critical, ESNA offers the "long-beam" locking device. The full cantilever of these sections assures protection against failures related to relaxation, creep and similar problems caused by the effects of extremely high temperatures upon metals. (Ask for ESNA Bulletin No. 5715 Design Manual for High Temperature Self-Locking Nuts.)



## Simplifying major substructure joining

An ESNA barrel nut doesn't have to be held for wrenching... doesn't need precisely mated bolt holes. The barrel-shaped fastener is simply finger-pressed into a drilled or reamed hole until the special clip snaps into position at the bolt hole location. The .030" float of the nut section of this fitting avoids misalignment problems and the bathtub recess for wrenching area is eliminated. New NAS 577 barrel nut (180,000 psi) now available. Also 160,000 and new 220,000 psi series.



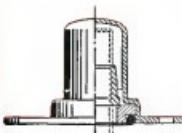
## Applications requiring guaranteed high reusability through more than 50 on-off cycles.

Where repeated tear-down and reassembly or frequent readjustment is required, the exceptional elastic memory and non-galling characteristics of ESNA's standard nylon locking insert guarantees long lasting locking torque and fastening dependability. Available in all sizes and configurations of standard aircraft type nuts. Parts can also be designed to order and in any standard configuration, with guaranteed re-use factors as high as 300 on-off cycles.



## Attaching components in areas with limited wrench clearance.

Minaturized insert-type hex nuts with across-the-flats dimensions as small as .109 in. in the 0-80 size . . . or all metal (.550" F.) nuts to AN365 or NAS 679 performance specifications with internal wrenching hexagon flats (which permit use of smaller wrench sizes) are available for use at locations where space and weight limitations are paramount. Complete lines of NAS miniature anchor nuts in carbon steel and A286 stainless steel are also in production. Ask for your copy of the NAS/ESNA Conversion Book.



## Sealing against fuel tank leakage

No danger of highly volatile fluids past bolt threads with ESNA's self-sealing, floating anchor cap nut! The one piece cap unit is provided with "O"-ring seal around its base which seals immediately the nut is riveted to the surface. The self-locking nut enclosed within the cap has .025" float to compensate for misalignment. Also available in gang channel nut strips.

## -----WHAT ARE YOUR FASTENING PROBLEMS?-----

Dept. N49-525, Elastic Stop Nut Corporation of America  
2330 Vauxhall Road, Union, N. J.

Please send me details on the following:

- Installing access panels
- Sealing against leakage
- Fitting in limited space
- Bolting non-parallel surfaces
- Simplifying substructure joining
- Assuring high re-usability
- NAS/ESNA Conversion Book
- Bulletin No. 5715 High Temperature Design Manual

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City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

**ELASTIC STOP NUT CORPORATION  
OF AMERICA**

